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GOVERNMENT POLICY AND ATTITUDE TO THE FUTURE OF AUSTRALIAN AGRICULTURE

J. McEWEN

Australian agriculture, in Government policy making, cannot be considered in isolation. It is an important part of the total national economy and Government policy and attitude towards agriculture recognises this fact.

The general policy of the present Government includes certain economic objectives, important among which are fostering the growth of the economy in respect of population and development of resources, sustaining reasonably full employment and promoting rising living standards while maintaining overall stability and adequate defence.

Agriculture has a major contribution to make. That contribution may be summed up as to provide adequate food for our growing population and a major portion of the exports which must finance imports necessary for our development in this period of rapidly changing technology.

The means used by a Government to encourage and assist agriculture's contribution are, of course, to some degree determined by the broader social and economic policies of that Government. It must be remembered that the present Government believes in political and economic freedom and relies basically on the profit motive to encourage increased production in agriculture. Furthermore the profit motive acts as an indicator for producers as to the most desirable lines of production. This has the corollary that opportunities within agriculture must not be

out of line with those in other forms of activity within the economy. However, it does not mean that the Government has no role to play. Broadly the role of Government may be summarised as being to encourage and develop an economic climate within Australia wherein production will increase to meet our needs and to assist producers to produce efficiently and to market successfully without the Government itself normally engaging directly in production or marketing.

Before looking in more detail at the Government's policies for the present and the future it will be informative to look backward a little to see how present policies have developed.

Post War Period

In 1951/52, as an aftermath of the war-time and post-war difficulties, the volume of agricultural production was only 3 per cent. above the average of the three pre-war years. The same period however had seen a population increase of 24 per cent.

These facts, in conjunction, meant that the country's export capacity was declining whilst the need for a growing export income was

The Rt. Hon. J. McEwen is Deputy Prime Minister of Australia, Minister for Trade, and Leader of the Federal Country Party.

This article is based on an address given to the A.C.T. Branch of the Institute on October 22, 1959.

becoming more and more imperative as a great era of industrial development in Australia got under way.

The decline in export capacity was masked for some time by high wool prices which reached a peak in 1950/51. When wool prices fell drastically the following year the weakness underlying our overseas payments position became clear. The figures in Table 1 show the changes that occurred in our export earnings, our import payments and our reserves.

TABLE 1

	Exports f.o.b. * £ million	Imports f.o.b. £ million	Inter- national reserves June 30 £ million
1949/50	605	538	629
1950/51	988	742	803
1951/52	678	1,051	372
1952/53	863	510	561

* Including gold production.

In this situation the Government made the most important declaration of agricultural policy ever made in peace time by the Commonwealth Government. The following statement made by me to the Australian Agricultural Council in 1952 embodies the Government's attitude:

The Commonwealth Government has decided to adopt as its policy objective a Commonwealth-wide programme of agricultural expansion not only to meet direct defence requirements but also to provide food for the growing population, to maintain our capacity to import and to make our proper contribution to relieving the dollar problem.

The Council agreed that the expansion programme should be given quantitative expression and asked the Commonwealth to set out desirable and practicable production levels for major commodities in five years' time. These production aims were submitted to the April, 1952 meeting of the Council, and after some amendments were unanimously adopted by the Council.

Policy which Emerged in 1952

The Government had previously co-operated with the producers, and in a number of cases with overseas Governments, in establishing a marketing framework within which the profit motive could operate to guide individual producers. This marketing framework included such things as stabilisation schemes, guaranteed prices, overseas contracts for bulk sale of commodities and long-term agreements such as the United Kingdom-Australia Meat Agreement under which the U.K. agreed to take until 1967 all available exports of Australian meat at reasonable prices.

Although under the Constitution most matters relating to agricultural production are the responsibility of the States, a considerable degree of initiative remained with the Commonwealth and within the existing marketing framework the Government turned its attention to making sure farmers could obtain the goods and services necessary for production and providing such other incentives as it could. To achieve the former aim direct negotiation was undertaken in a number of cases with manufacturers. Also, under strict import licensing which was introduced to cope with the serious balance of payments position outlined above, care was taken to ensure the materials necessary for farmers' requirements were available in adequate quantities. The extension services which are a vital link in disseminating to farmers the latest findings of research are basically a State function but the Commonwealth provided special funds to step up these activities. It has, in fact, over the past ten years provided approximately £11 million for research and extension in addition to such funds as go to the States through normal Commonwealth-State financial channels, and to its own substantial expenditures through C.S.I.R.O. Liberal depreciation allowances in taxation assessments were allowed to primary producers in addition to the allowances already operating for farm improvement and developmental work. These special allowances included the writing off over a short period of the whole of the expenditure (up to a stated limit) on employees' accommodation.

TABLE 2

Commodity	Unit	Prod. Aver. (Pre war)	Low Point Since 1938/39	Production 1958/59 *
Wool (Greasy)	m. lbs.	997	936 (1945/46)	1,577
Wheat (Production)	m. bushs.	165	53 (1944/45)	213
Sugar	'000 tons 94 n.t.	804	524 (1943/44)	1,412
Butter (Factory production)	'000 tons	182	135 (1951/52)	191
Cheese	'000 tons	25	27 (1940/41)	43
Beef and Veal	'000 tons	569	406 (1945/46)	901
Mutton and Lamb	'000 tons	319	274 (1950/51)	474

* Subject to revision.

It must be stressed that in this drive for greater production there was no attempt to say to farmers "you must produce this and that". The need of the nation was painted in clear terms. The stage was set for profitable production and the duty of individual producers to exploit these opportunities in their own and the nation's interest was made clear.

Present State of Rural Industries

Progress since 1952 within the industry has been a success story. The declared aim then was to increase the volume of production from the existing 3 per cent. to 21 per cent. above pre-war by 1957. In fact this was achieved by 1955/56 and by 1958/59 production was 53 per cent. above the pre-war level. 1958-59 saw record production in many lines and the story of progress is shown in Table 2.

Unfortunately the influence of this increase in output on exports has been partially offset

by a deterioration of 30 per cent. of Australia's terms of trade (i.e., the relation of the prices of our exports to the prices of our imports) between 1951/52 and 1958/59. The increases in production have not therefore led to fully commensurate gains in export earnings.

One consequence of the decline in overseas prices has been a fall in the share of the national income obtaining by farming. In 1951/52 net farm income was £441 m. or 13.4 per cent. of national income. In 1958/59 it was estimated at £408 m. or 8.1 per cent. of national income.

Not only has the total quantity of production increased so has rural productivity, i.e., production in relation to the number of workers employed. Productivity in the rural industries in 1958/59 showed a gain of 115 per cent. compared with 1920/21 and 72 per cent. compared with the pre-war years.

TABLE 3

	1920/21	1936/37-1938/39 (Av. three years)	1958/59
Index of <i>volume</i> of rural production	69	100	153
Permanent rural employment (males)	346,000 (estimated)	396,600	355,000 (estimated)
Index of Productivity	1.0	1.25	2.15

The factors underlying the adverse price movements during the period under consideration were in most cases only partly if at all under Australia's control. They included such things as the recent world recession which happily is now improving; the undue protection of their own high cost agriculture by a number of industrial countries; the export on non-commercial terms of surplus production which in some cases has been produced under high Government support prices or other incentives; the failure of the rules of international trading, as recognised in the General Agreement on Tariffs and Trade, to operate as successfully for primary products as for secondary goods. Some of these difficulties stemmed from balance of payments problems which have affected the international trading of many countries since the war and inability to trade freely has been accentuated by lack of purchasing power in the under-developed countries.

Present Policy Approach

On the production side present policies are essentially a continuation of those described above as being developed to meet the situation in 1952. In addition to ensuring that the necessary materials are available for production as well as research and extension facilities to assist producers in the most efficient methods the Government has had two major aims in the field of financial policy. First to guard against inflation and ensure that producers' costs are not forced up to levels where they are unable to compete and secondly to see that shortage of credit does not restrict desirable development. It is, of course, not the role of the Government to interfere with the relations between the banks and their individual clients but it has been Central Bank policy to see that the banks have adequate funds to lend on reasonable terms. When funds were restricted to curtail inflation, steps were taken to see that agriculture received special consideration. Furthermore the Government has realised that special institutions may be required for special needs and has recently passed legislation to set up a Commonwealth Development Bank one of whose functions

will be to provide credit to agriculture where it would not otherwise be available on reasonable terms. In such cases the test of credit-worthiness will be largely the potential productivity of the investment proposed.

On the marketing side the Government role continues to be to facilitate sale after production within a system of free enterprise based on the profit motive. The Government sees its role as to overcome obstacles, to co-operate with producers in selling their products and to negotiate general marketing opportunities for them. Sales promotion and advertising within Australia the Government sees as the responsibility of the individual industries. In some cases, as for example lamb, doubts may be felt as to whether everything possible has been done by the producers in this matter. Overseas the Government has worked strenuously to seek new markets and enlarge existing ones and to preserve markets where these are threatened. The Trade Commissioner Service has been expanded and now provides service to traders in nearly all the main countries of the world.

In the field of overseas trade promotion expenditure in the U.K. for 1959/60 is estimated at £1,272,000 of which £396,000 is to be provided by the Government, £176,000 by the Marketing Boards and £700,000 by firms, respectively. Much of the last amount is "induced" expenditure by firms on the advice of the Trade Publicity Unit in the U.K. and further moves are being made to encourage the importers who handle Australian goods in the U.K. to join in this publicity campaign. Steps are being taken to extend these publicity efforts to other countries.

Trade agreements have been made with a number of countries including U.K., Japan, Malaya, Ceylon and, most recently, Germany. Space prevents any discussion of these in detail but major successes were achieved in protecting our markets in these countries and in gaining new marketing opportunities for our exporters. In the case of the U.K.-Australia Agreement the amendments have resulted in better balance in the preferences mutually accorded between U.K. and Australia.

The right to lower the preferences applicable to the U.K. in appropriate cases was obtained. This gives Australia valuable room to manoeuvre when negotiating with other countries and helps to keep costs of goods and materials imported into Australia lower than they might otherwise be. With Japan very valuable concessions were obtained, particularly with respect to our exports to that country of wool, wheat and other grains. This Agreement, despite some contention at the time it was made, has operated over the past two years in an atmosphere of mutual consideration and, in general, has given satisfaction to both sides. In the case of the German Trade Agreement our arguments against import practices by Germany to which we have objected have been recognised and adjustments made with important gains for Australia.

We are prospectors rather than planners where trade promotion is concerned and this is well illustrated by the fact that over the past 5 years 10 Trade Missions comprising normally up to 30 leading businessmen and industrialists have gone abroad vigorously seeking export opportunities.

To protect our markets unremitting efforts have been made through the machinery of General Agreement on Tariffs and Trade and in other international forums to curb practices by our competitors which we considered not in conformity with the generally understood rules of fair international trading. Similarly in our trade agreements with other countries we have sought to have included provisions which would ensure appropriate action by ourselves and our trading partners in the event of dumping by third parties in the markets of either. Arising out of the Food for Peace conference convened by the President of the United States a Wheat Utilisation Committee has been set up on which Australia is represented. Through this Committee it is hoped workable arrangements will be achieved to increase the amount of foodstuffs going to under-developed countries to speed up their development without at the same time injuring the normal commercial marketings of other suppliers such as ourselves. Australia has never opposed the gifts of food to needy

countries where this food could not otherwise be purchased by them and has herself, through the Colombo Plan and otherwise, made efforts to relieve distress and to speed up development in the under-developed countries, particularly those close to us in South-East Asia.

Perhaps the greatest threat to our producers in their overseas marketing comes from the violent fluctuations in commodity prices. These can suddenly and disastrously affect not only incomes of individual producers but also Australia's international balance of payments and our reserves of gold and foreign exchange. At the Financial and Economic Conference at Montreal in 1958 Australia was a strong advocate for action to promote greater stability in the world commodity markets and it is pleasing to note that since then the International Wheat Agreement has been renegotiated, with the U.K., who was not a member of the previous Agreement, as a participant and also the International Sugar Agreement has been renewed. As well as the Commonwealth countries represented at the Montreal Conference the United States has agreed to a case-by-case study of the possibility of international arrangements to give greater stability and predictability in the price of individual commodities.

The Future

Where do we go from here? The Government sees agriculture's role as still its traditional one and believes that increased exports will be necessary to pay for the increased imports which will be required to sustain the growth of our rapidly expanding population and economy. The inflow of overseas capital in recent years has been large. This is welcome and it is hoped it will continue. However, it would be imprudent to rely on this capital inflow increasing to such a level as might be necessary to offset a growth of imports without any corresponding growth in our exports.

Amongst our exports rural products look like remaining the main-stay. At the present they account for about 85 per cent. of total exports. However, overseas markets for rural commodities are not likely to be easy and producers will need, and will get, the

Government's assistance in pursuit and maintenance of outlets for their products. The stabilisation arrangements in Australia will be continued or extended where producers arrive at agreement with the Government and in the international field efforts will be continued to extend further the benefits already achieved under trade treaties and commodity arrangements.

The Government does not see revolutionary changes in policy at this stage as either necessary or desirable. Emphasis must be on increasing productivity and lowering costs. In this field research and extension have a major role to play and there will be no slackening of the Government's support. Marketing is likely to continue as a challenge and a struggle. We must produce quality goods at prices to suit our customers and the Government will continue to press for fair trading opportunities in international forums and by bilateral negotiations as well as co-operating to the full in sales promotion and trade publicity.

In conclusion the Government's policy is one of balanced growth for the nation as a whole. Agriculture plays a very important part in this overall balance, especially in the contribution it makes to export earnings. Recently agricultural production has been increasing at an encouraging rate. The Government intends to continue the policies under which this growth has taken place. It will continue its aid to producers in their search for more efficient and cheaper production, it will continue its efforts to protect and expand our marketing opportunities and it will assist producers to obtain both at home and in overseas markets greater stability and predictability in the returns for their produce.

Discussion

Question. The Chairman asked Mr. McEwen to comment on the Institute's survey "Agricultural Scientists in Australia", saying that extension services seemed to be the cinderella section of the profession.

Answer. Mr. McEwen replied that, from memory, he thought the survey had revealed that salary scales in the State agricultural services were, in general, below Commonwealth scales. The extension workers were mainly employed in the State services. His

support could be counted upon in any endeavours to induce a climate where this part of the profession would be more attractive to people of calibre in the required numbers. He was fully aware of the need for the highest possible level of efficiency and morale in the research and extension services.

Question. Mr. Christian referred to recent arrangements for liaison between C.S.I.R.O. and the relevant Commonwealth administrative departments on technical matters relating to particular crops and asked whether there was need for further development of such arrangements.

Answer. Mr. McEwen replied that he personally, and he felt sure the Government also, would welcome and give careful consideration to views the Institute might submit at any time on the technical aspects of major agricultural issues.

"If there is some gap I suggest you are the very people who can advise on improving the channels for advice and suggestions to us—I would welcome such a move to improve the two-way flow and assure you of my wholehearted support," he added.

Question. Are greater exports of secondary products likely to offset the growing import requirements of an expanding economy?

Answer. Mr. McEwen said that he is repeatedly pointing out to manufacturers that they are Australia's biggest importers and should increase their exports so as not to be dependent for their imports on export earnings of other sectors. There is a need to find markets for new products as well as additional markets (such as Asia) for the normal export products. The Government does not plan to switch from traditional markets to Asia. In fact, the Government is not planning but prospecting, and by energetic and appropriate methods proposes to prospect continuously for new markets.

Question. What are the Government's views on a national fodder reserve scheme?

Answer. This is really a matter for the Minister for Primary Industry. The Government has not yet formulated a policy. Mr. McEwen said he could see the stabilizing effects of such a scheme but speaking as a farmer, he was in favour of producers making their own reserves. If there were great fodder reserves these could remove some inducement to the more prudent and energetic producers who have fodder to sell in bad periods.

Question. What is the Minister's attitude on sugar cane growing? (Reference was made to the fact that one million tons of the Australian crop had to be left unharvested through over-production.)

Answer. No bulk commodity in world trade has a better recent history of stability in returns than sugar.

This arises from national and international regulation and if these arrangements broke down stocks of sugar would greatly exceed the markets. There is an obligation to find new markets for excess sugar—not necessarily as sugar, but as a source of other products and particularly as fodder material. There was scope for the agricultural scientist in this field.

Question. Had any thought been given to relieving the poverty sections of agriculture?

Answer. A policy of supplementing sub-standard incomes is not contemplated. It would not get at the causes of the problem. However, with the dairying industry, government policy has been to sustain the industry at an average level but the gap between the most and least efficient producers is very great. This policy has not solved all the problems of the industry and a dairy investigation committee has been appointed to make a thorough study of the industry and make recommendations to the Government.

Question. What was the Government policy towards a newly developing industry such as linseed or saf-

flower? Should such an industry be encouraged on the grounds that Australia should be self-sufficient?

Answer. Self-sufficiency irrespective of costs is a policy which Australia has been attacking when practised by other countries. It is not one which Australia itself should adopt. A reasonable level of protection for an industry that gives promise of being economic and efficient is alright. The need for, and the level of, such protection is, in Australia, a matter for the Tariff Board. If the Board finds that local production is not economic then the problem is back with the scientist and research worker, aided by such government assistance as is warranted.

Question. What are the Minister's views on the growing of cotton in Queensland?

Answer. Australia ought to be producing much more of her cotton requirements—but the future of cotton production is in the hands of the agricultural scientist. The Government is paying 14d per lb for seed cotton as a price support. This is a reasonable level. The rest is up to the scientist.

Book Review

Minor Elements and their Effects on the Growth and Composition of Herbage Plants

By R. Dorrington Williams

Commonwealth Bureau of Pastures and Field Crops, Mimeographed Publication No. 1/1959. (pp. 68). Obtainable from the C.A.B. Liaison Officer at 314 Albert Street, East Melbourne, C. 2., Victoria. Price 9/5d.

As Dr. Williams notes in an early section of this publication, "Australia, and to some extent New Zealand, has the severest deficiencies of minor elements so far recorded; all the minor elements are deficient, often several at the same time". The practical value of minor elements in the transformation of country of low productivity has long been recognised in Australia, but even on a casual glance through the text of this publication, the reader cannot but be impressed by the extent to which Australian research has contributed to the understanding of minor element problems—not only in the recognition and control of field deficiencies but also in the elucidation of the functions of these elements in the physiology of the plant.

Dr. Williams' publication consists of 34 pages of text in which a well balanced account is given of the minor element content of herbage plants and the biological, edaphic, climatic, and other factors affecting this content, as well as the practical applications—diagnosis and alleviation of deficiencies and excesses. A useful feature of the text is a table bringing together a large number of observations on the content of seven minor elements of more than 30 herbage plants. The 30 page bibliography appears to be exhaustive and the volume will undoubtedly be of great value to scientists and others interested in plant nutrition.

W. IVES.



Your life is more pleasant with Wine

THE POLL DORSET

C. H. S. DOLLING

The first volume of the Flock Book for Poll Dorset sheep in Australia was published by the Poll Dorset Association in 1955. In it were 18 registered flocks. In volume 5 there are 247 registered flocks in which a total of over 15,000 ewes was recorded as being joined to produce the 1959 drop. Most flocks are in the south-eastern section of the continent, New South Wales, Victoria and Tasmania having 89, 82, and 28 flocks respectively. There are 27 flocks in South Australia, while Western Australia has 13 and Queensland 8.

Poll Dorset sheep have been exported from Australia to England, South Africa, and New Zealand.

Reasons for Breeding of Poll Dorsets

The Poll Dorset Association was founded in 1954 to foster the establishment of Poll Dorset sheep, and to collect and publish information relating to them. The aim of breeders is to evolve a polled Dorset Horn and not to develop a radically different breed of sheep. Many of the reasons put forward for the development of the Poll Dorset are similar to those put forward for the Poll Merino which have been summarised by Dolling (1959). They include a reduction in poll flystrike of rams, the general argument that polled rams may be more productive than horned rams, and the greater ease of handling of polled animals.

There are also a number of reasons which are specific to the Dorset (Reddin, private communication). The central axis of the curl of a horn of a Dorset Horn ram points almost directly forwards, while that of a Merino ram points outwards from the skull. A result is that Dorset Horn ram horns may curl in and press on the eye or nose, which may enhance the area's attraction to the blowfly. Vision in

Dorset Horn rams is reduced if the horns have a close curl. A Dorset Horn ram lamb may have appreciable horn growth at birth which necessitates a greater amount of attention at lambing time in pure Dorset Horn flocks.

All Dorset Horn ewes are, of course, horned. Their horns also sometimes curl in to the eye and face. Dorset Horn crossbred lambs from Merino ewes are horned, and any breakage of horns of these lambs during transport can result in the lambs becoming blood covered and unattractive.

Sources of Polledness

Flock book records show that polledness has been introduced from the Ryeland and from the Corriedale, and that it is claimed to have appeared spontaneously in the Dorset Horn.

There are eleven Poll Dorset flocks which might be termed foundation flocks, but some have had a greater influence than others on the development of the breed.

Only a small number of individual sheep have contributed polledness to the Dorset Horn in these flocks. In six foundation flocks based on the Ryeland, the progeny of approximately seven Ryeland rams and not more than 100 Ryeland ewes were retained as ancestors of all Poll Dorsets. In three foundation flocks based on the Corriedale, the comparable figures are three rams and five ewes. In the two flocks in which a mutation within the Dorset Horn breed is claimed, two rams were concerned. There have been several transfers

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of Poll Dorset sheep between some of these eleven flocks in recent years.

Figure 1 depicts the numbers of breeding ewes joined to produce the 1958 drop in flocks with a Ryeland only, a Ryeland-Corriedale, a Corriedale only, a Corriedale-Dorset Horn, or a Dorset Horn only base. It is seen that most of the ewes joined to produce the 1958

drop in Poll Dorset flocks had a Ryeland ancestor.

Reference has been made to two Poll Dorset flocks in which the foundation animals are claimed to have been born of Dorset Horn parents. Polled sheep in these flocks have been accepted by the Poll Dorset Association as being 75 per cent. Dorset Horn, and have

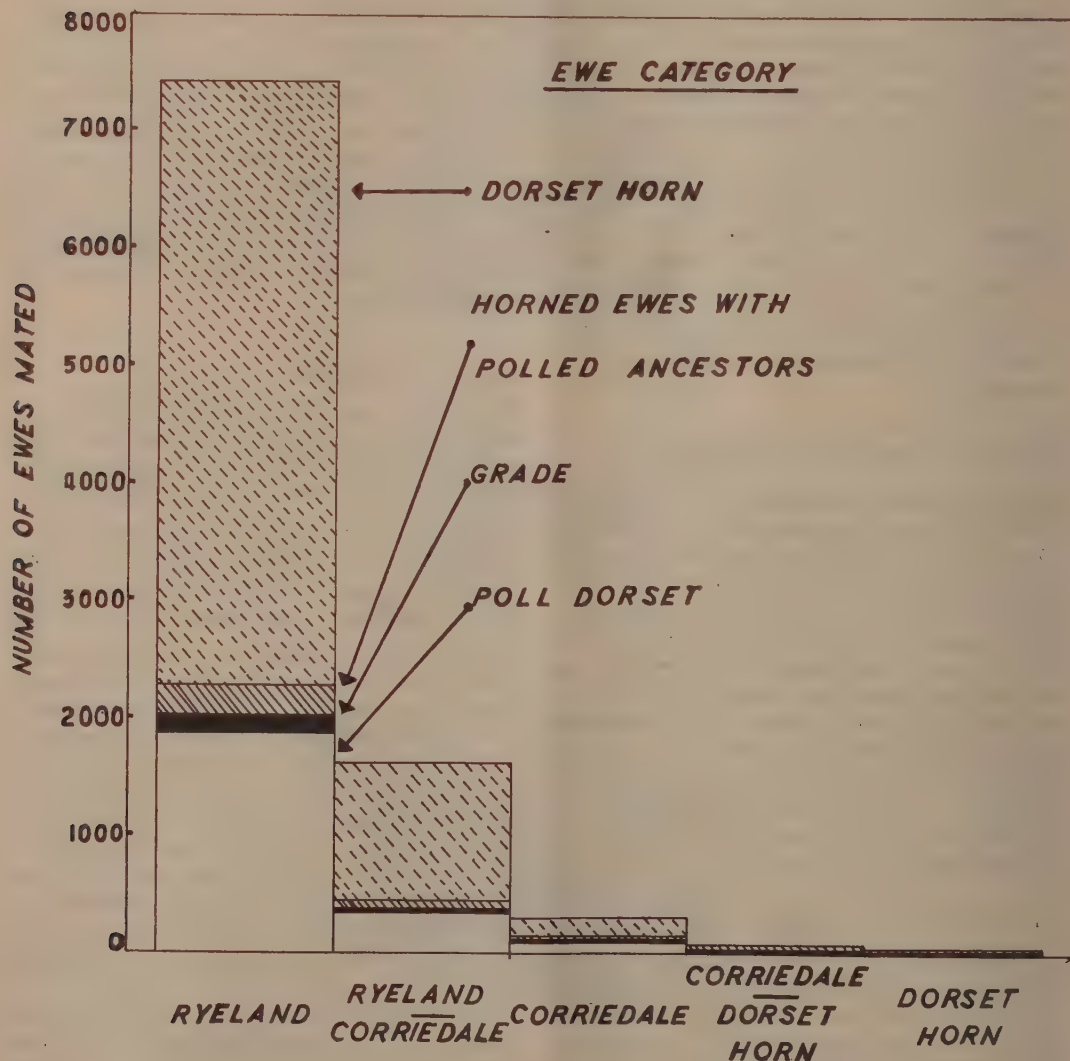


Figure 1—Number of ewes of each category, recorded as being mated to produce the 1958 drop, with Ryeland, Corriedale or Dorset Horn ancestry.

therefore been required to undergo further back-crossing before being accepted as Poll Dorsets. This will aid in ensuring that, should some polled sheep have arisen not from mutations but from an unsuspected migration of poll genes from an outside source, the Poll Dorset will remain as much like the Dorset Horn as possible. A recorded instance of a mutation to polledness in the North Carolina State College Dorset Horn flock is of interest. No detailed descriptions of phenotypes have been published but the observations appear to be explicable by a gene mutation in one Dorset Horn ram.

Definition of Poll Dorset Sheep

A Poll Dorset sheep "must contain at least 95 per cent. registered Dorset Horn blood before it becomes eligible for transfer, registration, or exhibition at Shows". The breed type of the Poll Dorset, given in the Poll Dorset Flock Book, is similar to that of the Dorset Horn, and includes a white face with pink nose and lips. As the Poll Dorset breeder is aiming to produce a Dorset Horn without horns, he aims, of course, to retain the desirable characteristics of the Dorset Horn. These include its long breeding season, rapid growth rate and good carcase conformation, and open face, which is important where grass seeds are troublesome.

A "poll" animal is defined by the Poll Dorset Association as "one which has never shown horns firmly fixed to the skull".

Show Societies in Australia now generally list the Poll Dorset with other breeds of Australasian origin, the Corriedale and Polwarth, rather than with the British Breeds.

Inheritance of Polledness in Poll Dorset

The basis of the inheritance of polledness in the Merino has been summarised by Dolling (1959). It involves a series of triple alleles P , P^1 and p . Briefly, the dominant gene P produces polledness in both sexes, although some PP^1 or Pp rams grow long scurs or aberrant horns. The intermediate gene P^1 produces horns in ewes. Homozygous recessive pp rams have normal Merino ram horns, while pp ewes have bone knobs or short scurs. Observations on one large and one small Poll

Dorset flock and on other unpublished matings are explicable on the same basis, with an amplification of the range of phenotypes in ewes of the genotype PP^1 . Some Poll Dorset ewes have bone knobs topped with short scurs on their horn sites, and no typical depressions; these ewes are probably PP^1 . This coincidence does not, of course, prove that the inheritance of polledness is the same in both breeds, but it does suggest that Poll Dorset breeding plans should be based on the Merino hypothesis until inconsistencies arise.

This much is known, however. There is a gene which produces horns in Dorset Horn ewes which is either identical with, allelic with, or closely linked to the gene P^1 of the Merino (Dolling unpublished data). For practical purposes, therefore, the Dorset Horn breed may be considered homozygous for P^1 .

If the Ryeland and Corriedale breeds are assumed to be PP , the process of creation of a Poll Dorset flock amounts to the replacement of the P^1 genes of the Dorset Horn by the P genes of one of these two polled breeds. This is done in three stages. The first is the introduction of P by migration from the polled breed. The second is the back-crossing of polled offspring from these matings to the Dorset Horn until polled sheep which are 95 per cent. Dorset Horn and of a satisfactory quality are produced. All polled sheep born during this stage would be PP^1 . The third stage involves the interbreeding of Poll Dorset sheep. It is not until this stage that the frequency of P in polled animals is increased above its level in the first and second stages, namely 0.5. Selection for other desirable qualities is also, of course, practised in the third stage. A more detailed consideration of the stages summarised here has been given by Dolling (1957, 1958).

Development of Poll Dorset Flocks

The three foundation flocks which have had most influence on the development of the Poll Dorset were founded by 1943. In Figure 2 are plotted the numbers of registered flocks founded each year since 1937, and the total number founded up to any given year. The total number of flocks increased slowly to

1947. No further flocks were founded until 1953, after which the rate of increase has risen sharply.

There are four categories of ewes mated in Poll Dorset flocks. 1. Poll Dorset ewes, which are polled and contain at least 95 per cent. Dorset Horn blood. 2. Grade ewes, which are polled sheep with between 50 and 95 per cent. Dorset Horn blood. 3. Dorset Horn ewes. 4. Horned ewes which have a polled ancestor, which must be equivalent to Poll Dorset ewes

in their percentage of Dorset Horn blood. In Figure 3 are plotted the numbers in each category recorded in flock books as being joined to produce the five drops from 1955 to 1959 inclusive.

Fewer than 1,000 ewes of all categories were joined to produce the 1955 drop. Since this mating the number of grade ewes joined has remained constant, but the number of Poll Dorset ewes has increased sharply. The increase in the number of new flocks founded,

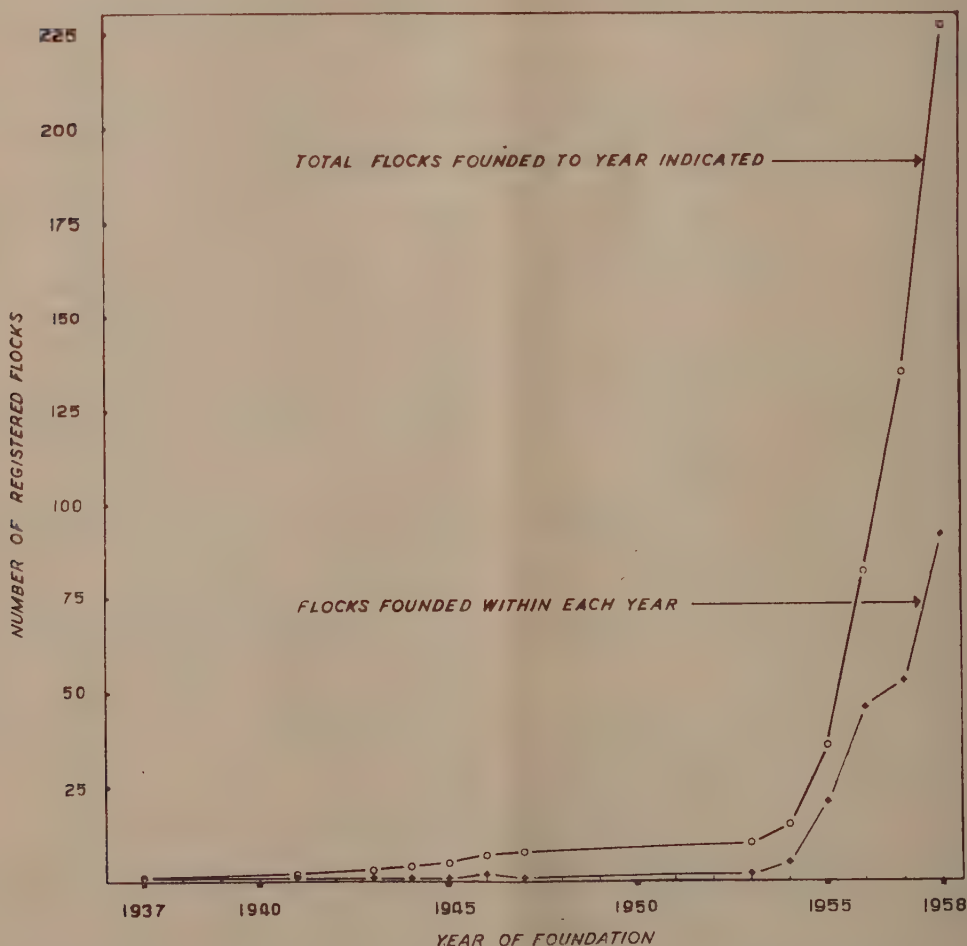


Figure 2—Number of registered Poll Dorset flocks founded in each year from 1937-1958, and total number of flocks founded up to and including each year in this period.

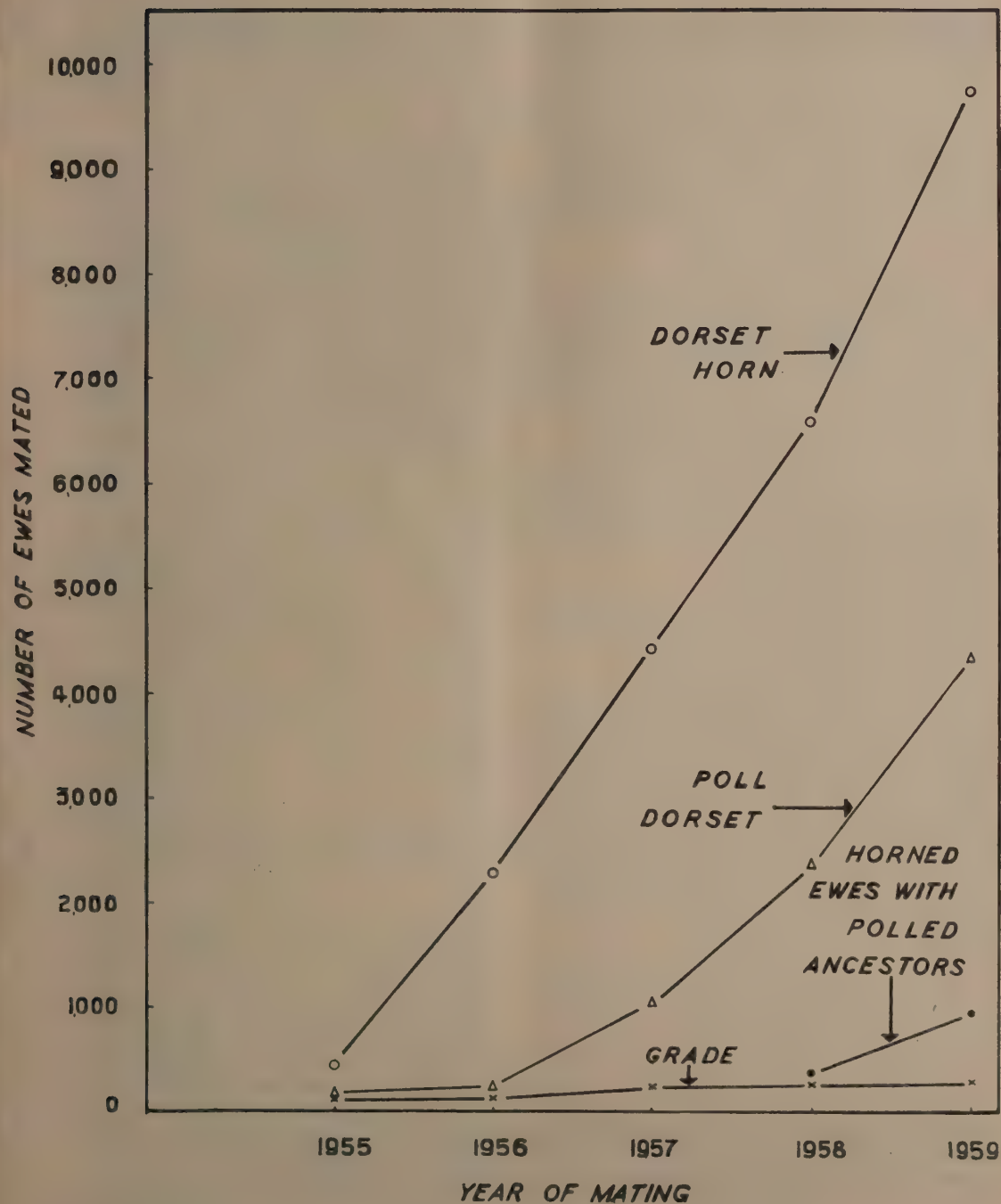


Figure 3—Number of ewes of each category recorded in Poll Dorset Flock Books as being mated to produce each drop from 1955 to 1959 inclusive.

often with a Poll Dorset ram and Dorset Horn ewes, is reflected in the steep increase in the number of Dorset Horn ewes mated. Matings such as these, if with PP¹ rams, will produce ewes of the fourth category. The mating of these horned ewes of polled ancestry has been recorded for the last two years only, and the substantial increase in number mated reflects the increase in number of such ewes available.

Polledness and Other Characters

In any selection programme, the inclusion of additional characters reduces the intensity of selection which can be applied to any of them. In stages 2 and 3, when selection against long scurs and aberrant horns in PP¹ males may be practised, for example, less selection pressure will remain for regaining the desirable characters of the Dorset Horn. As selection against these horny growths in stage 2 will not increase the frequency of P, it could be practised lightly only, allowing more rapid progress to be made in other characters.

In spite of this disadvantage of increasing the number of characters for selection, several characters just must be considered.

During the back-crossing stage of the development of the Poll Dorset, many characters of the parent polled breed will be present in the grade sheep. One such character which was reported by Elliott (1950) was the restricted breeding season of the Ryeland, which proved a handicap in the mating of F₁ ewes to Dorset Horn rams. The ewes had a very low conception rate in October-November matings. Selection against this limitation is essential.

There is no information on pleiotropic effects of P being expressed in the Poll Dorset, or on any genes linked closely with P.

The Future

The information in Figure 3 indicates that the relative proportions of ewes of each category which are mated each year are changing. In Figure 4 an attempt is made to trace some causes of these changes. The possible destinations of progeny of Poll Dorset rams (PP

or PP¹) and ewes of each category are outlined. For example, if a PP¹ Poll Dorset ram is mated with Dorset Horn ewes, half of the offspring will be eligible to become Poll Dorsets, half will be horned ewes of polled breeding.

The number of Dorset Horn ewes mated will increase by migration from outside while new flocks are being founded or existing flocks enlarged. As offspring from PP Poll Dorset rams are all eligible to become Poll Dorsets and those from PP¹ rams may become either Poll Dorsets or horned ewes of polled breeding, the Dorset Horn group will obviously not add to itself. Its numbers will drop once sufficient Poll Dorset breeding ewes become available.

On the other hand, the number of horned ewes of polled breeding may receive additions from the several sources indicated within breeding flocks as they now stand. If of suitable merit, these ewes are mated with Poll Dorset rams, but they have no intrinsic worth in Poll Dorset breeding, being neither polled nor 100 per cent. Dorset Horn. They are valuable only while better breeding ewes are limited in number.

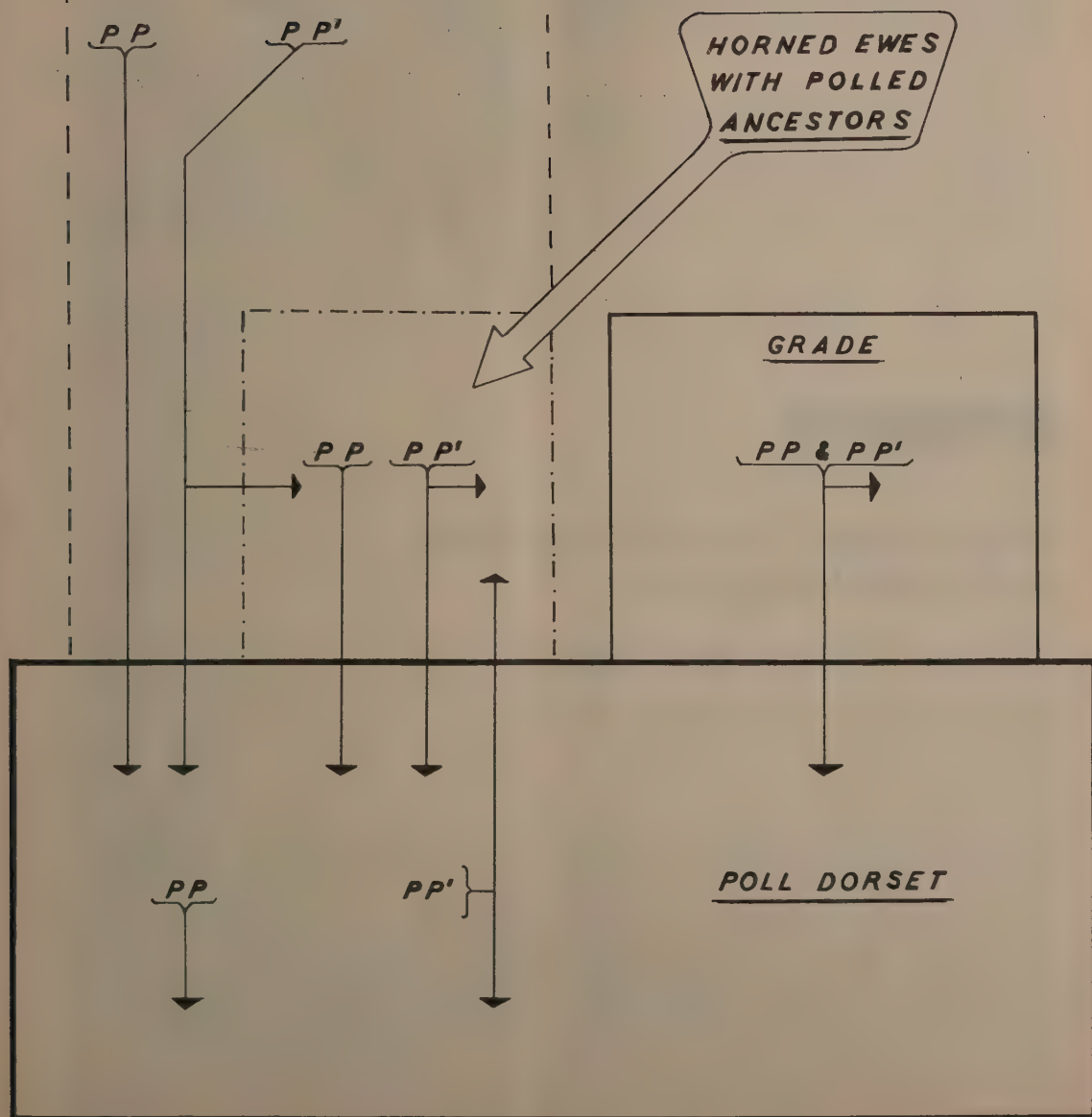
The number of grade ewes joined has remained at a constant low level. The grade ewe flock now receives additions only from within itself because no new grading projects are being started. The existing grade ewe flock will dwindle as existing members die, and as more Poll Dorset and fewer grade progeny are born to grade ewes.

The Poll Dorset ewes themselves receive additions from all four ewe categories. They lose ewes to the horned ewes of polled breeding, offspring of the mating of two heterozygous Poll Dorset sheep. This loss will be progressively reduced as the frequency of P increases in Poll Dorset ewes and their mates. Figure 4 does not take into account any downgrading of ewes, offspring of two Poll Dorset parents, which might be made on general merit other than polledness.

Whereas in the past the percentage of Dorset Horn blood carried by each Poll Dorset sheep was required for registration purposes,

DORSET HORN

Figure 4—Destinations of progeny of Poll Dorset rams (PP and PP') mated with ewes of each category.



this requirement has now been dropped. This recording is a good safeguard during the grading stage, but is not necessary once numerous Poll Dorset rams are joined with Poll Dorset ewes, as is now the case. As mentioned earlier, the end of the grading stage in the creation of the Poll Dorset breed is in sight.

Some flocks may need to ensure that their degree of inbreeding does not become too high. There are enough unrelated animals in the breed for this if suitable transfers are made between flocks.

After the frequency of P has been raised to a high level in Poll Dorset sheep, the possibility of improving selection for economic characters by some form of objective measurement could well be considered. A high growth

rate is a most desirable character in the Dorset Horn. Body weights taken at several ages would give an accurate record of growth rate, and should improve the accuracy of selection.

Acknowledgements

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Book Review

Abstract Bibliography of Fruit Breeding and Genetics to 1955. *Rubus* & *Ribes* a Survey

By R. L. Knight and Elizabeth Keep

Commonwealth Bureau of Horticulture and Plantation Crops, Technical Communication 25 (pp. 254, 1007 annotated references). Obtainable from the C.A.B. Liaison Officer at 314 Albert Street, East Melbourne, C.2, Victoria. Price 56/3.

In compiling this manuscript the needs of practical fruit breeders, working with currants, gooseberries, raspberries, blackberries and hybrid berries, have been the first consideration. Being themselves fruit breeders, the authors have abstracted the relevant data from a wide range of literature, some of which would not normally be covered by abstracting journals dealing with this aspect of horticulture. (Specialist abstracting journals in this field have existed for less than thirty years.) Papers and reports bearing on the breeding, genetics, and cytology of *Rubus* and *Ribes* have been summarized in de-

tail, but the field has also been extended to include pomological descriptions, the classification and synonymy of varieties and species, and their disease and pest response. In addition, gene lists and linkage data are given in appendices. Papers dealing solely with the systematic botany of these two genera have been included by title only. In all, over 1,000 abstracts and titles arranged alphabetically under authors, are included in the manuscript, and these have been indexed in considerable detail.

W. IVES.

PROGRAMMING FOR FARM MANAGEMENT EXTENSION

M. L. PARKER

Postwar development of Australia's agriculture can largely be attributed to the progress made in agricultural research and the subsequent adoption of research findings by farmers. The value of extension in this development is now widely acknowledged. This is not to say that further progress cannot be expected in the extension services.

Agricultural extension in Australia has centred about the creation of an awareness, among farmers, of the value of research findings and new techniques. There is evidence, however, to suggest that extension services are developing along a wider front, and that farm management and rural sociology will come to play a more important role in this development.

Evidence of the growing interest in farm management comes from both farmers and professional agriculturalists. In a few instances farmers have already taken the initiative in establishing farm management clubs whereby they jointly employ full-time advisers. An increasing number of farmers have also been seeking advice from, and encouraging the establishment of independent consultants. Agriculturalists have welcomed these developments, which are merely in their infancy, as means of increasing the efficiency of agriculture and the status of their profession (Moore 1959).

The purpose of this article is to enlarge upon the idea that successful farm management extension will require the backing of farm management laboratories (Schapper 1959).

Farm Management Laboratories

To function efficiently, an extension service requires an adequate flow of new research results. This applies to both technical and farm management extension. Between the laboratory and the extension worker there is liaison, which "helps to identify research findings which have use as a basis for new farm practices" (Williams 1959).

The distinction between technical and farm management extension is not always clear. It is one of degree rather than kind. For this analysis it is convenient to consider technical extension as extension which, for the most part, is concerned with creating an awareness of specific research results. Techniques of pasture development, weed and pest control, soil conservation and plant and animal nutrition can be thought of as falling within this category. The media of mass communication (radio, press and farm journals) are generally used in the extension of this type of information. One consequence of this is a tendency for recommendations to be of a generalized nature; that is, each recommendation is designed for consideration by farmers who may differ widely from one another in their goals and willingness to take risks, etc., and whose properties differ in size, working capital, etc. This is not to say that workers engaged in technical extension are unaware of differences between farms;

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but that they can take them into account only within the limits imposed upon them by the media of mass communication.

Farm management extension may be thought of as taking a rather broader view of farmers' decision-making. The approach is that of the whole farm. The objective is to assist the individual farmer to identify and evaluate whatever alternatives are open, given his total farm resources and his farming goals. As specific technological developments become known they are taken into account in so far as they influence the feasible alternatives. The farm management adviser helps the farmer with the whole of his plan, not only those parts of it for which the research findings are conclusive. The mass media of extension are generally not well suited to this approach. The need is for constant personal contact between farmers and farm management advisers.

The differences between technical and farm management extension, although only of degree, are sufficiently great to warrant specialised laboratory services for each. Farm management research, like technical research, can contribute to increases in agricultural productivity. Several Australian studies have suggested that this contribution may be substantial (e.g. Dillon 1956; Schapper and Mauldon 1957). However, whereas technical extension is at present backed by laboratories and field stations of Departments of Agriculture and C.S.I.R.O., comparable institutions do not yet exist to service farm management extension. It is submitted that farm management laboratories are needed for this regardless of whether farm management services develop through clubs, private consultants or through the existing extension services.

Farm management research is concerned with describing trends in production techniques and cost and income levels; with analysing the decisions of farmers; and with studying the efficiency of farm production (Williams 1953). Any laboratory servicing farm management extension workers could be expected to concentrate upon the latter field of research. This includes analysis of the effect of alternative farming practices and organizations on

net farm incomes. It raises the questions of what to produce, how much to produce and how much of each input (fertilizer, feedstuffs, etc.) to use. Answers to such questions form the basis of the farm planning approach to extension whereby farmers and advisers together examine feasible alternatives and estimate the costs and returns accruing to selected improvements to the existing farming system.

The tools of farm management research, particularly those relating to farm planning, are still being developed. However, one tool known as linear programming has already been applied to widely differing problems in agriculture. In Australia, these problems have included the determination of low cost poultry feeds and the determination of overall crop and livestock plans for particular farm situations. The logic of this technique and its general application under Australian conditions have been discussed by Mauldon (1958). The remainder of this paper is devoted to an example of programming as it might be applied by a farm management laboratory. Use is made of some of the data from a 1958 farm survey conducted jointly by C.S.I.R.O. and the Institute of Agriculture, University of Western Australia. A full report of this survey will be published separately.

An Example

One hundred and eight farms selected at random from the Kojonup district of Western Australia were classified according to the amount of cleared land, labour and fixed resources and the availability of capital. Linear programming was then used to find the most profitable patterns of production for each class of farm. Initially farming methods and levels of efficiency common to the district were used. The procedure was then repeated using above average yields to reflect a superior level of efficiency. Finally several plans were tested for their stability in the event of changes in prices and yields, or errors of forecasting.

With few exceptions, the most profitable plans for each class of farm were found to be stable over a wide range of yields and prices. That is, wide changes in yields and

prices did not introduce new sets of optimum plans.

Figure 1 and Table 1 illustrate the method used in the Kojonup study to select the most profitable combination of enterprises on a farm of 3,300 acres. Figure 1 depicts the maximum contribution to net returns made by each of the enterprises at various levels of working capital, where the farm is operated with above-average management, at 1957-58 prices and costs. These are the combinations of enterprises which, at these prices and yields, give maximum net returns before deducting fixed costs.

Points A_1 A_2 — A_7 , in Figure 1, represent levels of working capital at which investment opportunities change. Thus, given £6,400 of working capital the most profitable plan (A_4) includes wheat, six-row barley, baby-beef and wethers. The actual acreages and livestock numbers are indicated in Table 1. It can be seen that the 2,550 wethers are maintained from an associated flock of 1,120 ewes, and that 210 acres of oats are required for hay and grain supplements.

The net return to plan A_4 (before deducting fixed costs) is £14,900. This could not be exceeded by any other combination of the twelve feasible enterprises considered for

inclusion in the farm plan. Given additional amounts of working capital, however, the net return could be increased by adopting a plan such as A_5 . Optimum plans for intermediate levels of capital (between the A's) can be determined graphically from Figure 1. Beyond A_7 land is limiting and any additional outlay of working capital would not alter this optimum plan.

Farm Planning Aids

There are numerous problems and methods of solution which a farm management laboratory could examine with benefit to liaison services and farm management advisers. In the above example, linear programming was used to examine only one of the major decisions confronting farmers, namely, the choice of farm enterprises.

An extension of the procedure outlined above indicated that many Kojonup farmers had adopted farming patterns for which the actual net return was only 50 per cent. of the possible return (using the same amount of working capital and the same farming techniques but an alternative combination of enterprises). The majority of these farmers seemed unaware that such gains could be made or, alternatively, were unaware of the

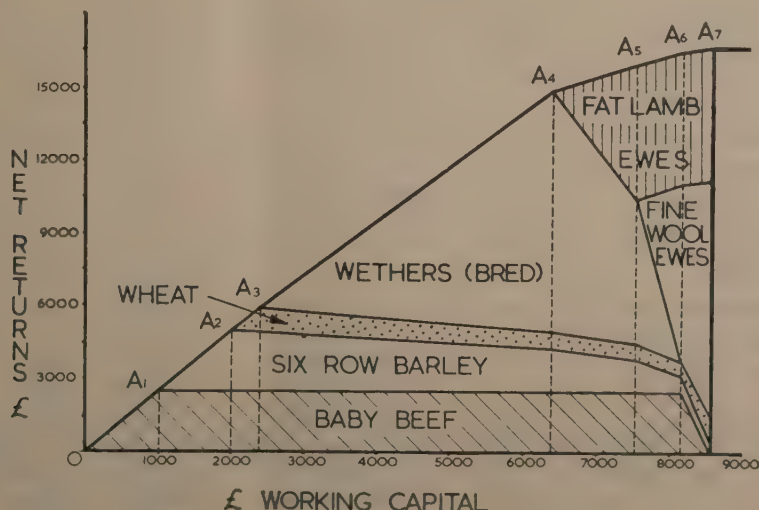


Figure 1—Graphical representation of the farm plans outlined in Table 1

amount of income forgone as a result of their desire to retain their existing farming programme.

Limited inquiry into the disparity between the plans actually in use and the plans which were found to be most profitable for individual farmers at the time of the survey revealed the following points. Firstly, farmers had insufficient information about production alternatives to be able to consider them as genuine possibilities. Secondly, in their planning, farmers were restricted by their beliefs and valuations. Thirdly, their ability to compare alternative practices was limited by their uncertainty regarding the outcome of such practices.

If this challenge is to be met there is a need to provide farmers with more farm planning information. However, it is not likely to be sufficient to rely solely upon the experience of the local adviser. Most advisers would have considerable experience in the type of farming of their district; but ex-

perience has its own difficulties. The adviser is likely to be influenced by the preconceptions and prejudices of his district. He too, is likely to think in terms of the current farming patterns, rather than in terms of feasible alternatives.

To overcome this disability there seems to be a need to develop farm planning skills within the extension service. It is the adviser rather than the farmer, in the first instance, who needs to be provided with farm planning aids which will assist him to visualize the relationship between particular combinations of farm resources and the farm plans which are feasible for each of these situations. No single plan can be expected to be applicable to all farms within a district. The best plan for any one farm will depend upon the availability of capital, plant and machinery, land and labour, the stage of development of the property, the soil type and other physical characteristics, and the aspirations and ability of the farmer. It is because there is this

TABLE 1

Optimum plans for a Kojonup farm of 3,300 Acres. Labour force two men: above-average management: 1957 prices.

Enterprises Included	Farm Plans						
	A ₁	A ₂	A ₃	A ₄	A ₅	A ₆	A ₇
Hay (acres)	70	70	70	70	70	70	
Oats (acres)				140	200	300	380
Wheat (acres)			130	110	100	90	150
Six-row Barley (acres)		350	350	230	170	80	20
Beef Cattle	120	120	120	120	120	120	
Wethers				2,550	1,530		
Breeding Ewes				1,120	670		
Fine-wool Ewes						1,850	2,590
Fat Lamb Ewes					1,500	1,500	1,500
Idle Land (acres)	2,700	2,350	2,220				
Working Capital (£)	1,020	2,010	2,370	6,400	7,510	8,170	8,560
Net Return (£)	2,590	5,040	5,870	14,900	15,960	16,440	16,660

multitude of variables, together with the price and yield uncertainties to which agriculture is prone, that farm planning is commonly contended to be impractical. The fact remains, however, that farmers do plan, even if this involves merely the decision to carry-on as before.

If extension workers are to assist farmers to make still better decisions in their farm planning, these variables must be taken into account. Fortunately farm planning tools are being developed to make this possible. However, because some of them, for example linear programming, require the skill of an expert, they can only be handled in farm management laboratories. As a result, plans are likely to be developed in terms of representative rather than individual farms. The example shown above was of this nature.

Presenting the Farm Plan

As a means of developing farm planning skills within extension services, it is probably sufficient that farm management laboratories provide advisers with summarized plans for typical sets of farm resources. Accompanying each plan there would need to be a detailed statement of the costs, prices, yields and farming methods used.

Plans would be capable of modification to allow the analyst and the adviser to depart from the initial set of assumptions and to explore alternatives. The plans in Figure 1 and Table 1 are for varying levels of working capital and a particular combination of land, labour, machinery and farming goals. The effect of varying any of these farm resources or of introducing other assumptions regarding the farmer's willingness to undertake risk or his desire for leisure time or alternative farming activities, etc., could similarly be examined. Likewise the effect of changes in prices or yields could be considered, and the ranges within which each plan would be stable could be determined. The objective is not to provide exact solutions, but rather a framework for further planning by bringing to light the net outcomes of a full range of alternatives. By matching individual farms

against representative farms for which programmes were available, the farm management adviser could more readily assess the nature of the problem and the scope which exists for improvement.

The question arises whether the same technique could be used to induce individual farmers to accept improved farm management practices. It may be possible for advisers to convince groups of farmers of the value of particular farm plans by presenting them in graphical form such as in Figure 1. In the absence of detailed explanations, however, this could lead to false conclusions and confusion in the minds of farmers.

How then are farm advisers to encourage individual farmers to identify and evaluate the alternatives open to them? Exposure to information does not guarantee adoption. To initiate action, opportunities must first be accepted as achievable and as desirable alternatives. Consequently there is the problem of presenting plans in a form which will encourage their consideration as the basis for action.

Programming cannot be directly used in this way. It can help identify the most profitable plan for a given set of resources; it cannot teach the farmer to apply the plan to his particular farm situation. A further planning aid is needed. This would be the farm budget used firstly to set out and analyse the farmer's existing plan, and then to present the results of the laboratory's programme. The budget would enable comparisons to be made between an actual farm plan and laboratory determined optimum plans. It would open up for discussion between the farmer and the farm management adviser, the whole range of problems relating to resource use, technological advances, farming goals, etc. This application of the budget is to be distinguished from its traditional use as an aid in identifying and choosing between a number of plans, any of which may or may not be the best plan. It is in the failure to consider programming and budgeting as complements, rather than as alternatives, that some of the criticism of programming, as a tool of farm management extension, finds its origin.

Conclusion

Farmers and professional agriculturalists have recently shown considerable interest in the need to strengthen existing advisory services by means of farm management extension. Any such movement which improved farmers' economic decision-making can be expected to result in substantial increases in agricultural production. Regardless of the method used to introduce farm management extension, there is the need to ensure that advisers receive a flow of information which will enable them to deal specifically with the problems of farm organization and management. All advisers engaged in farm management extension could benefit from the services of a farm management laboratory or centre in much the same way as existing extension workers depend upon the already established field stations and research and diagnostic laboratories.

It is not valid to assume that more technical research is needed before farm management laboratories can be useful. Certainly many technical problems remain to be solved and the development of farm management studies will suggest further problems. But farm management decisions must be made in the absence of complete knowledge and where farmers are forced to make these decisions unaided, or where farm management extension is undertaken without adequate economic information, the errors involved are likely to be great.

Fortunately techniques already exist which can provide farm management workers with

farm planning aids. Linear programming has been shown to be one such technique which, however, can be widely applied only through a farm management laboratory.

Acknowledgements

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USEFUL CORRELATIONS BETWEEN RESULTS OF FERTILIZER TRIALS AND OTHER FIELD DATA

C. B. WELLS

Field fertilizer trials and pot culture trials are a satisfactorily direct way of finding, for a particular site and crop, the nutrients which should be added as artificial fertilizers, as well as the amounts and proportions of them that are necessary. But such trials are both expensive and time consuming. Other kinds of data which could conceivably be used to extend and supplement the results of such trials for use over wider areas are the chemical analyses

of soils, visual descriptions and classification of them, geology and geological history.

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The data in this paper is from part of an address originally prepared and presented to Section K. of A.N.Z.A.A.S. in Adelaide, 1958, under the title "Soil Analyses and Plant Responses to Applied Fertilizer".

Figure 1—Response and lack of response to potassium in southern South Australia (after Tiver, 1955).



Figure 2—Response and lack of response to manganese in southern South Australia (after Tiver, 1955).



Figure 3—Response and lack of response to copper in southern South Australia (after Tiver, 1955).



Figure 4—Response and lack of response to zinc in southern South Australia (after Tiver, 1955).



Figure 5—Response and lack of response to molybdenum in southern South Australia (after Tiver, 1955).



The purpose of this paper is to test and demonstrate the relationships existing between these two kinds of data as collected so far in parts of South Australia. *

Data

The agronomic data selected here as a test case are those reported by Tiver (1955) and Trumble and Ferres (1946). These concern, respectively, field trials with micro-nutrients, and pot culture experiments with some major and micro-nutrients.

A. Field Trials Reported by Tiver (1955).

Figures 1-5 are a re-presentation in somewhat simplified form of the data given in Tiver's map, as well as some recent additions to it (Tiver, private communication). They show the sites of present day recordings of sufficiency and deficiency for the micro-nutrients copper, zinc, molybdenum and manganese. Some data for the major nutrient potassium

are also recorded. Phosphorus is not concerned as it was invariably used as a basal dressing, and nitrogen is not involved since nearly all the results are based on leguminous pastures which therefore have an internal nitrogen source.

B. Pot Culture Trials Reported by Trumble and Ferres (1946)

In studying these results free use was also made of the original records contained in Pot Culture Book 'B', held at the Waite Institute, Adelaide, where the trials were carried out. A wide variety of South Australian soils (and some others from interstate) was used. Most of the samples were from surface soils only. Phosphorus is not concerned as it was invariably applied as a basal dressing, nor is nitrogen since the test medium was a herbage legume in all cases chosen. The nutrients involved are potassium, manganese, boron, copper, zinc, molybdenum, magnesium, iron, and vanadium, sometimes singly and sometimes in various combinations. The sampling sites from which the soil samples were taken are distributed in

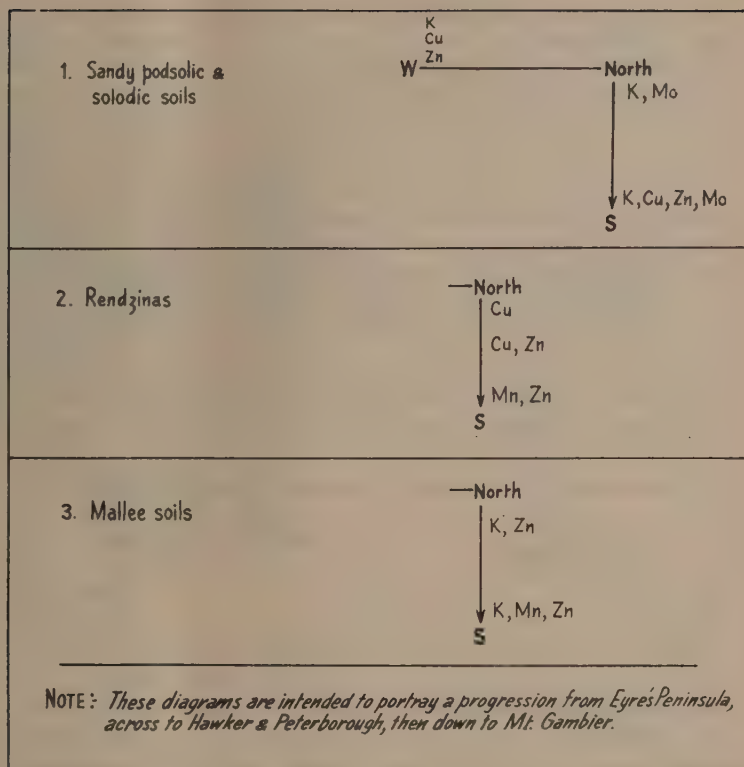
* The relationships with chemical analysis are presented as Table 4 in Wells (1959) and will not be included in this present paper.

TABLE 1

Plant responses to fertilizers in relation to kinds of soils.

SOIL	Responses recorded					Remarks
	K	Mn	Cu	Zn	Mo	
Siliceous sand			X	X		Podsolization
Podsolized sand	X	X	X	X		
Podsol	X	X	X	X	X	
Lateritized soils	X		X	X	X	Lateritization & Solonization
Sandy solodic and podsolic soils	X		X	X	X	
Siliceous solonized soils	X		X	X	X	
Volcanic soil		X				Soils of Calcareous aggradation (either recent or dominating)
Peat		X	X	X		
Coastal calcareous peat		X	X	X		
Calcareous sand		X	X	X		
Rendzina		X	X	X		
Shallow red calcareous soils		X	X	X		Soils in varying stages of calcareous degradation
Terra rossa			X	X		
Red-brown earth		X		X		
Mallee soil	X	X		X		

Figure 6—Responses in relation to locality and kinds of soils (Results from "Pot Culture Book, B"—Trumble and Ferres)



the same general pattern as the sites shown in Figures 1 - 5.

Trumble and Ferres (1946) state that responses indicated in pot culture work were in all cases substantiated in subsequent field trials. This means that considerable reliance can safely be placed upon an enlightened interpretation of results of glasshouse pot culture work. The only possible exception was with potassium, but recent work by Tiver (unpublished data) is providing field trial confirmation of this also.

Results

A. Geographical Distribution of Responses

Tiver (1955) has plotted the results of his trials, and some additional suitable data from other sources, both in terms of the responses themselves and in terms of the soils on which they occur. When the data from Pot Culture

Book 'B' † are treated in the same way, an inspection of the two sets of results together reveals a number of interesting facts.

Among these are that there is a sensible geographic distribution of responses to the micro-nutrients, and furthermore the distribution thus found is different for each of them.

Another fact revealed is that different soils show their own particular spectrum of responses but these change in detail according to the geographical locality in which the soil is set.

Such observations immediately suggest that it might be useful to make a more careful examination of the plant responses in terms of kinds of soils, regional geology and geochemistry.

† It has not been possible to establish with certainty the classification of the soils used by Trumble and Ferres (1946) in their pot culture work, but an attempt has been made to do so as reliably as possible.

B. Comparison with Pedology, Soil Description and Classification

The result of grouping the responses according to the kinds of soils on which the trials were made is shown in Table 1.

It can be seen from the remarks column in Table 1. that the grouping of the responses falls into a pattern which is reasonably explained in terms of present-day concepts of soil forming factors and processes. This picture is, however, a general one and therefore necessarily only a first approximation.

Figures 6 and 7 show how the responses recorded for a given soil will vary depending upon the geographic locality of the trial or

sampling site. These should be compared with Figures 1-4, which have shown that there is a reasonably consistent geographic distribution for each response. The two sets of data are closely related, yet, clearly, there must be some discriminating influences at work to produce the perceptible degree of independence that can be read into these results. It might not be unreasonable to suggest that regional geology (including geological history and geochemistry) is the underlying broad-scale controlling influence in nutrient supply, and that local pedogenesis is a further, superimposed influence tending to re-route the general geochemical trend. Further support for this is given in the section which follows.

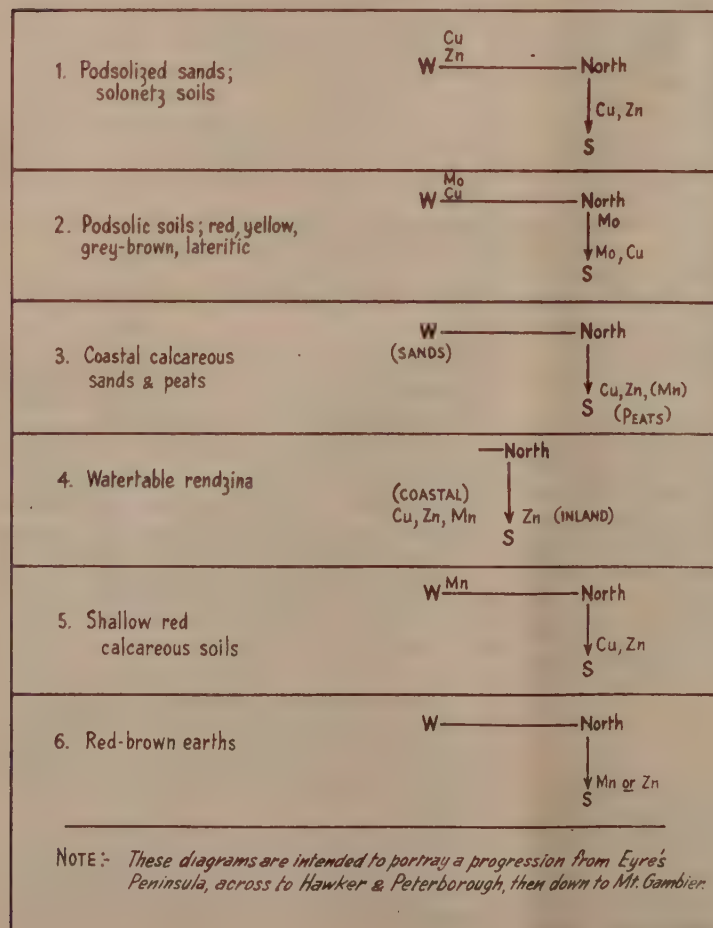


Figure 7—Responses in relation to locality and kinds of soils (Results from Tilver, 1955).

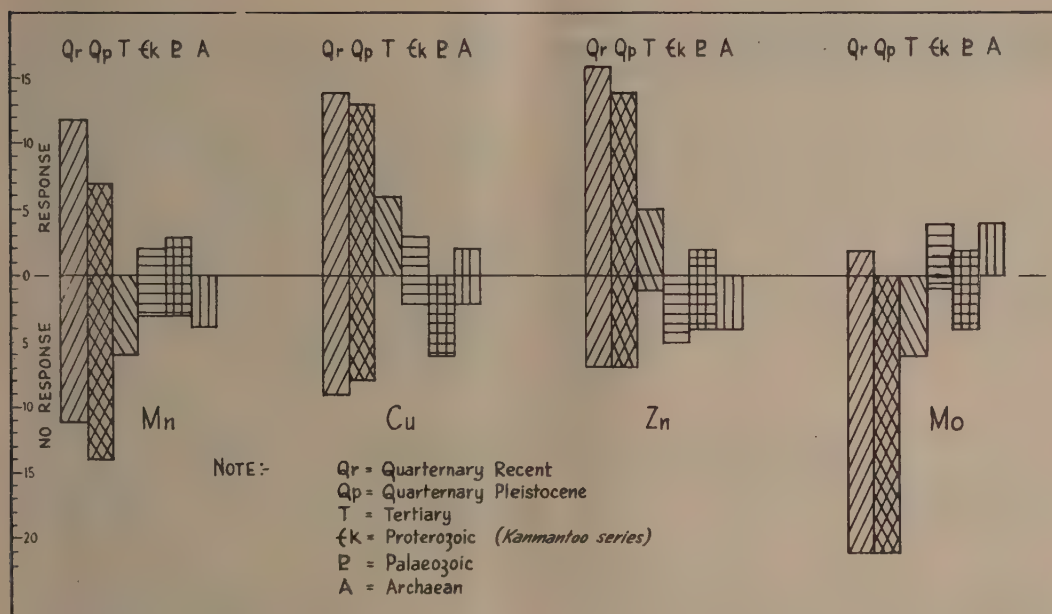


Figure 8—Responses to micro-elements on various geological materials for South Australia.

C. Comparison of Responses with Geology

Figures 8 and 9 present graphically the results of a study to find if there is a relationship between the plant responses obtained at Tiver's

(1955) sites and the age of the underlying geological material. It can be seen that in some cases positive responses were always found on certain geological materials and that

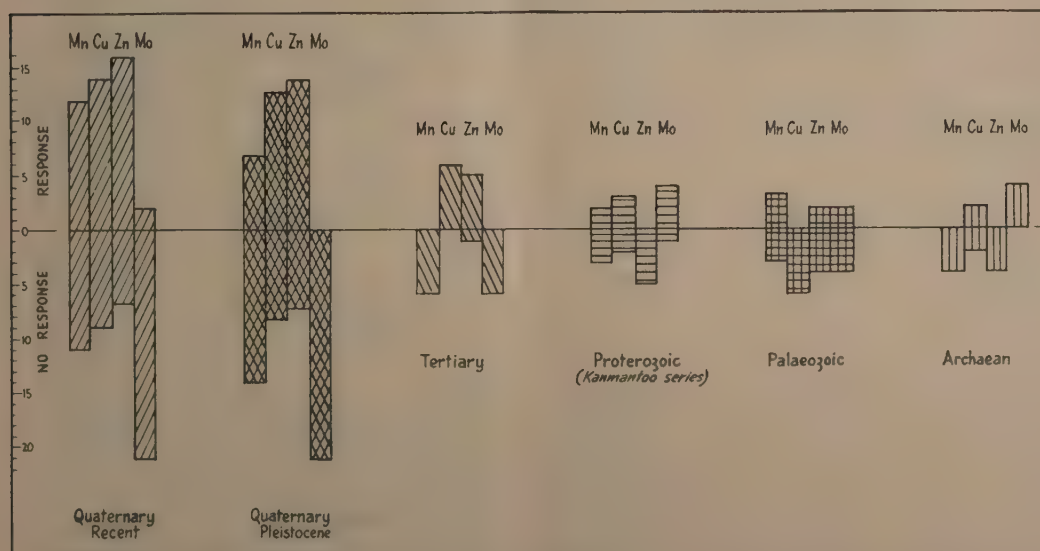


Figure 9—Micro-element responses found on each particular geological material—for South Australia

they never appeared on others. The relationship is unlikely to be clear-cut in every instance because plants are rarely grown on geological material itself but on the soils which have developed upon it. On the other hand a given geological material frequently gives rise to a restricted suite of soils.

The scatter, in Figure 9, of cases in which responses sometimes occur and sometimes do not, suggests that, for the nutrients here considered, the ages of the rocks *per se* are not as important to plant nutrient supply as their chemical composition and the geomorphic

surfaces which they now occupy. These, through their control of parent material, climate, erosion, accession, hydrology and vegetation, will determine the courses of soil forming processes and hence whether various nutrients are retained within the root zone, lost from it, or rendered unavailable within it. Geological age does however achieve a degree of separation between materials that happen to be of different composition, and must suffice at this stage until adequate geochemical studies have been made of the rocks and formations concerned.

TABLE 2

Plant responses on geological material for South Australia.

Geological material	Responses likely to:—	Responses possible to:—	Responses not likely to:—
Archaean	Mo	Cu	Mn, Zn
Proterozoic	—	Mn, Zn, Mo	Cu
Palaeozoic (Kanmantoo Series)	? Mo	Mn, Cu	Zn
Tertiary	Cu, ? Zn	—	Mn, Mo
Quaternary Pleistocene	—	Mn, Cu, Zn	Mo
Quaternary Recent		Mn, Cu	? Mo

TABLE 3

Relationship between plant responses and geology for South Australia.

Nutrient	Response usual on:—	Response possible on:—	Response unlikely on:—
Manganese	—	Proterozoic Palaeozoic Quaternary	Archaean Tertiary
Copper	Tertiary	Archaean Palaeozoic Quaternary	Proterozoic
Zinc	? Tertiary	Proterozoic Quaternary	Archaean Palaeozoic
Molybdenum	Archaean ? Palaeozoic	Proterozoic	Tertiary Quaternary

Conclusions

In view of the correlations shown to hold, it seems that results of field trials at a particular locality can be usefully extended, and with some confidence, to wider areas if suitable consideration is given to such other data as pedology, soil description and classification, and geology. The sum of these produces a comprehensible geographic distribution of responses.

Thus, for the present data, herbage legumes growing on soils in which podsolizing processes have been dominant will usually respond to additions of potassium, manganese, copper and zinc. Where lateritization or solonization have prevailed manganese is less likely to be deficient, but molybdenum becomes so instead. On the various calcareous soils there are responses to copper, zinc and manganese, but not usually to potassium and molybdenum at this stage.

Superimposed upon these, the relationships between underlying geology and plant respon-

ses to fertilizers are as shown in Tables 2 and 3. Hence, even in the absence of specific soils data, the results of field fertilizer trials can be applied satisfactorily to quite extensive areas.

Acknowledgements

Since the original material for this paper is the work of others the whole project was dependent upon their generosity and co-operation in making data available. Those particularly deserving of thanks are Professor C. M. Donald, Dr. R. J. Millington, Dr. D. S. Rice-man, Mr. N. S. Tiver and Mrs. M. Teesdale-Smith.

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Mistletoe Control on a Large Scale

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An account is given of a cheap and rapid method of applying injections of 2,4-D together with the results of a large-scale trial in which this method of application was used. A working plan which could be followed in any project to control mistletoe by the injection method is suggested.

Previous papers by Greenham *et al.* (1951) and Greenham and Brown (1957) have described results obtained from trunk injections of 2,4-D for controlling mistletoes on some species of eucalypt. The method of treatment mainly used in the work described in the above papers is satisfactory for research purposes, but is slow for large scale use. Brief reference has already been made to a more rapid method of application (Greenham and Brown 1957). This paper describes in more detail the method used together with new results obtained. Briefly the features of the method are: the dosage is determined in a single step, axe cuts are employed to receive the dose, and the dose is applied with a drenching gun.

Materials and Methods

The dose of material to be applied to a given tree is determined by the expression Kd^2 , where d is the diameter of the tree at breast height in inches (d.b.h.) and K is a dose

factor determined by experimentation. (See Greenham and Brown 1957, for discussion of results from various values of K). The application procedure formerly used entailed measuring d , working out Kd^2 by means of a graph, measuring out the indicated amount of 10 per cent. 2,4-D solution, and applying this to a number of equally-spaced holes bored around the trunk. The first two steps have now been combined into a single operation which indicates the number of cuts (instead of holes) to be made in a tree of given size, and the quantity of material to be placed in each cut. The material is applied to each cut by means of a variable-dose, automatic sheep-drenching gun with a knapsack type of container.

The dose to be applied to each tree is determined directly by means of a modified Biltmore stick. The principle of this total is given in most texts on forest mensuration, e.g., Bruce

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TABLE 1

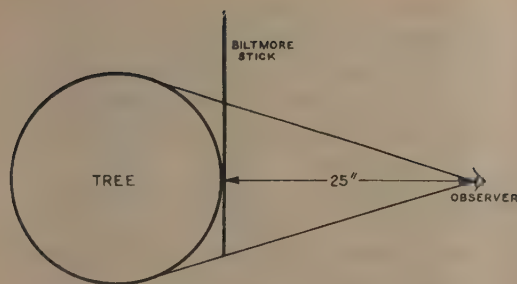
Biltmore Stick Graduations.

Figure 1—The Biltmore stick in use.

and Schumacher (1942). It is a straight rule about 30 in. long which is normally graduated so that, when held horizontally against the tree and observed from a distance of 25 in., tree diameter may be read directly. When the observer aligns the zero end of the stick with one edge of the tree, the line of sight to the other edge of the tree intersects the rule at the appropriate graduation. This is illustrated in Figure 1. By replacing the diameter graduations with values for cuts and dosage per cut a direct measure of the dosage is obtained for each tree. Appropriate graduations for trees of small average diameter (e.g. 8 in.) and for larger average diameter (e.g. 15 in.) are given in Table 1. These two scales are desirable since a single scale, which gives sufficient accuracy on smaller trees results in unnecessary sub-division of the dose in larger ones. Different dose rates may be applied by varying either the volume per shot and/or the concentration of poison.

The cuts are conveniently made by means of a 4 lb axe with the blade reduced to a width of 1½ in. as illustrated in Figure 2. It would be practicable to incorporate the Biltmore stick in the axe by graduating the axe handle if so desired.

An area of savanna woodland and dry sclerophyll forest near Gundaroo, N.S.W. was chosen for the experiment. The woodland contained mainly large *E. melliodora* A. Cunn., while the dry sclerophyll area was dominated by smaller *E. rossii* Baker and Smith, and *E. macrorrhyncha* F. Muell. Other species pre-

For Trees Averaging 8 in. Diam. Max. Diam. = 17.5 in.				For Trees Averaging 15 in. Diam. Max. Diam. = 33 in.			
Cuts	Shots per Cut †	Distance S* (in.)		Cuts	Shots per Cut †	Distance S (in.)	
1	1	3.2		1	1	5.1	
2	1	4.0		2	1	6.6	
3	1	4.6		3	1	7.6	
4	1	5.3		4	1	8.4	
5	1	5.8		5	1	9.2	
6	1	6.3		6	1	9.9	
7	1	6.7		7	1	10.5	
8	1	7.2		8	1	11.1	
5	2	7.8		9	1	11.6	
6	2	8.5		10	1	12.1	
7	2	9.1		11	1	12.5	
8	2	9.6		12	1	13.0	
9	2	10.1		13	1	13.4	
10	2	10.7		14	1	13.8	
6	4	11.5		15	1	14.1	
7	4	12.2		8	2	14.7	
8	4	12.8		9	2	15.3	
9	4	13.4		10	2	15.9	
10	4	14.0		11	2	16.5	
				12	2	17.0	
				13	2	17.5	
				14	2	18.0	
				15	2	18.5	
				11	3	19.2	
				12	3	19.8	
				13	3	20.4	
				14	3	21.0	
				15	3	21.5	

*S = the distance between the zero mark on the Biltmore stick and the division between consecutive dosage classes.

† A unit shot of 1 ml. of 10 per cent. solution results in application at rate C. Ten per cent. solution is obtained from the commercial 50 per cent. w/v preparation by adding four volumes of water to one of the concentrate.

‡ A unit shot of 2.8 ml. of 10 per cent. solution results in application at rate C.

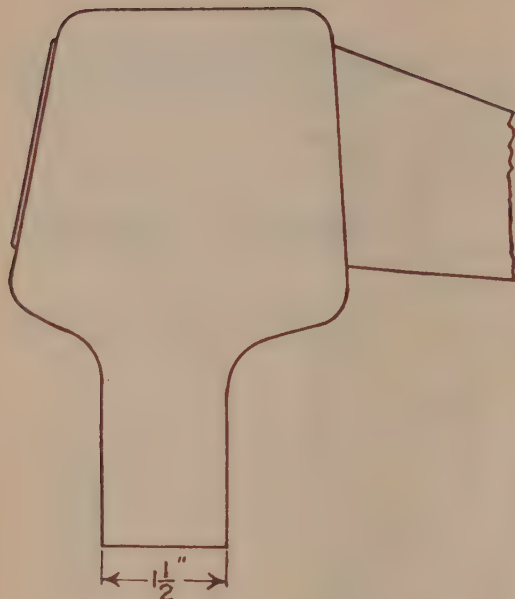


Figure 2—Outline of the axe used.

sent in the dry sclerophyll area included *E. polyanthemos* Schauer, *E. maculosa* R. T. Baker, *E. stuartiana* F. Muell., and *E. cinerea* F. Muell. Infestation by the mistletoes *Ameyma miquelii* (Lehm.) van Tiegh. and *A. pendula* (Spreng.) van Tiegh. was heavy, particularly on *E. polyanthemos*.

A two-man team carried out the actual work, one man measuring the trees and making the cuts, the other following and applying the solution with the drenching gun adjusted to apply 4 ml per shot.

Had the treatment been applied in bored holes, a value for K of 0.125 (Rate C) would have been chosen as a result of past experience. However, a preliminary trial conducted at Kowen, A.C.T., in which axe cuts were used suggested that some loss of effectiveness occurred compared with bored holes, so a value of $K = 0.177$ (Rate D) was used.

Results

The following amount of work was accomplished:

Number of trees treated = 699.

Area treated = 53 acres.

Time spent = 792 gang-minutes.

50 per cent. 2,4-D amine used (diluted to 10 per cent. before use) = 1.43 gallons.

Average time required to treat one tree = 1.13 gang-mins.

Average amount of 2,4-D used per tree = 0.0021 gals.

Diameter corresponding to average dose = 16.4 in. d.b.h.

The distribution of the treated trees by species was as follows:—

<i>E. polyanthemos</i>	641 trees	91.8 per cent.
<i>E. melliodora</i>	46 "	6.6 " "
<i>E. macrorrhyncha</i>	3 " "	0.4 " "
<i>E. cinerea</i>	3 " "	0.4 " "
<i>E. stuartiana</i>	3 " "	0.4 " "
<i>E. maculosa</i>	3 " "	0.4 " "

An examination was made of the accuracy with which the dose was applied, using as a standard the dose computed from a graph of Kd^2 , and measuring d with a diameter tape.

The following errors were detected:

- The application of poison in discrete amounts (i.e. 4 ml units).
- Errors in measuring the trees, due to:
 - Variation in the eye to tree distance of 25 m.
 - Ovality of leaning trees.
- Leaks in the drenching gun causing less than the nominal dosage to be applied.
- Operator bias. It was found that there was a tendency to raise the dose to points on the scale at which fewer cuts with more material in each cut were required. (Points A and B on Figure 3).

The errors due to the first two sources were of the following order:

Source	Average deviation from calculated dose
A.	0.0% $\pm$ 5.5%
B.	+ 11.5% $\pm$ 19.3%

An assessment of the effectiveness of the treatment was made nearly three years after the experiment was laid down, by which time

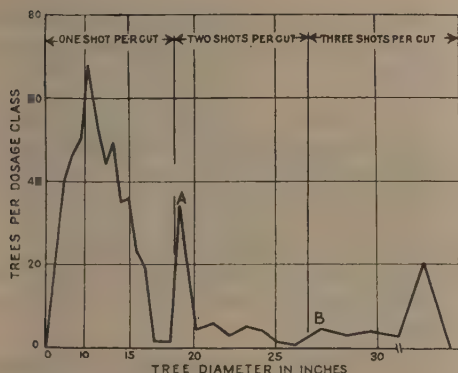


Figure 3—Frequency polygon showing the distribution of treated trees (dosages have been converted to corresponding diameters).

mistletoe deaths had practically ceased to occur. The area was divided into woodland and dry sclerophyll forest types, and a sample group of hosts was examined in detail in each type. The results of this examination are presented in Table 2. Treated hosts which were damaged but not killed by treatment had in general recovered at the time of assessment. Response by the various species treated was quite similar.

Discussion

An estimate may be made of the cost of treatment per tree in the following manner.

Assume:

- A. A labour cost of £15 per week per man, and an effective working time of 35 hours per week;
- B. A material cost of 90/0 per gallon of 50% w/v 2,4-D amine salt.

Then:

Labour cost per tree	= 3.88 pence
Material cost per tree	= 2.25 pence
Total	= 6.13 pence

for trees averaging about 16 in. in diameter, and treatment at Rate D.

It is believed that attention to the various sources of error listed, and a correction of those arising from source B. would result in an application of adequate accuracy. The substitution of a suitably calibrated girth tape for the Biltmore stick would minimise errors arising from this source, if at the expense of a slight increase in labour costs.

It is also believed that the difference in response shown in the two vegetational types was due to different crown width-trunk diameter ratios in each type. This factor was previously recognised as a difficulty inherent in the method of dose calculation employed (Greenham and Brown 1957). The method is intended to give trees of varying crown sizes equal doses of 2,4-D per unit crown

TABLE 2

Effect of 2,4-D on hosts and mistletoes.

Type	No. of Hosts	Hosts Killed		Mistletoe on Living Trees		
		No.	%	No.	No. Dead	% Dead
Dry sclerophyll	143	30	21	497	439	88
Woodland	17	1	6	73	28	38

Established 15-22.5.56

Assessed 23.4.59

area, using trunk diameter as a measure of crown width. In the woodland area the crown-trunk diameter ratios were appreciably greater than in the dry sclerophyll forest area; this could have been compensated for by increasing the dose rate in the former areas.

An alternative explanation to the above is that the difference in response was due to the difference in species between the two areas. However, former work has shown that the response to 2,4-D of the species in question is very similar.

The results of the treatment in the dry sclerophyll area are consistent with those obtained with the same rate of application employing bored holes. The loss of effectiveness which appeared to be present in interim results of the preliminary trial at Kowen, previously referred to, is not evident in the final results of either the Kowen trial or the Gundaroo work; in fact in the latter case, Rate C would have been adequate in the dry sclerophyll areas.

In view of the results obtained in this experiment, the following working plan might be followed in any project to control mistletoe on a large scale in a similar area:

- A. Divide the area into vegetation types, e.g., dry sclerophyll forest and woodland.
- B. Carry out a preliminary test preferably in autumn or winter treating 20-100 trees at for example the following rates in each vegetation type:
Dry sclerophyll forest — Rate C.
Woodland areas — Rate D or E.
It may be desirable to further subdivide these types, should one type show great

variation in stand density, as such variation would affect the ratio of crown to trunk diameter.

- C. After at least a year, treat the remainder of the area, making any adjustment to the dose rates which are apparently necessary in the light of results of the preliminary test.
- D. After about two years, retreat those trees which have not responded to treatments B or C.
- E. Should there be neighbouring untreated stands from which reinfection could occur, regular retreatments will be necessary.

Acknowledgments

Due acknowledgment is made of the advice and encouragement given in the course of this work by J. M. Fielding, Senior Forestry Officer, Forestry and Timber Bureau; and C. G. Greenham, Principal Research Officer, C.S.I.R.O. D. I. Nicholson, formerly of the Bureau, established the preliminary trial at Kowen. J. B. N. Osborne, Esq., of Bowylie, Gundaroo, kindly made the trees on portion of his property available for the experiment. I.C.I.A.N.Z. donated the 2,4-D (Amoxone) used.

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The Influence of Sod-Seeded Legumes on the Nitrogen Economy of Grassland Soils at Lismore, N.S.W.

J. W. McGARITY

Under the most favourable system of utilization, annual net positive increments of 40 to 60 lb of nitrogen may be expected after sod-seeding legumes into grass pastures on the North Coast of New South Wales. Walker's method of calculating gain or loss of nitrogen under mixed sward has been used to derive these values. The rate of increase in total soil nitrogen suggests that the sod-seeded pastures should be regarded as "fertility maintaining" rather than "fertility building" in respect of this element.

In recent years adoption of the rapid and relatively inexpensive method of pasture improvement by the sod-seeding of legumes has gained favour among dairy farmers in the high rainfall areas of the North Coast of New South Wales. Apart from the general benefits of improved milk production and a better balance of the pasture year, an additional factor which has undoubtedly induced an almost universal acceptance of the value of improvement of pastures in the Lismore district at least, has been the forecast of a soil "fertility buildup".

In view of this belief, some assessment of the level of soil nitrogen and the contribution of the sod-seeded legumes to the nitrogen economy of the soils of the Lismore district is warranted.

Levels of Nitrogen in Krasnozem Soil

Total Organic Nitrogen

The most important dairying soils are the krasnozems, and, although these are regarded as highly productive, butter yields have declined in recent years (Kingsland 1950).

Yellowing of the "natural" paspalum pastures and growth response in urine patches have been cited by Breakwell and Jenkins (1951) as visual evidence of a developing condition of nitrogen deficiency. Despite longer utilization, examination of the krasnozems of the district has shown that when compared with other great soil groups in the Richmond Region under pasture, the surface soil (0-6 in.) is generally far higher in total nitrogen (Table 1).

The period of utilization of the krasnozems under pasture has nevertheless affected the level of total soil nitrogen. A decline of 20 per cent. in total nitrogen since clearing of the rainforest some 60 to 80 years ago can be calculated for surface horizons from the data of Parbery (1940), confirmed by McGarity and Davey (unpublished data). The decline in total nitrogen is apparently rapid in the first few years under paspalum grassland, but

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once the soil nitrogen has fallen by approximately 20 per cent. from the total nitrogen level in the virgin soil, an equilibrium is reached and losses from a continuous grass pasture are apparently comparatively small. Where pastures have been re-established after a period of cultivation, the levels of total soil nitrogen are generally below this level, and difficulty is experienced in eliminating invading inferior grasses, e.g. *Axonopus affinis*. The total nitrogen content in soils under poorer pastures is of the order of 0.400 per cent. total nitrogen or less.

Mineral Nitrogen

Mineral nitrogen levels in surface soils under pasture range from 15 to 25 p.p.m. throughout the year, and almost all of this is present in the ammonium form. In urine patches, however, the content of both nitrate and ammonium-nitrogen is high; up to 64 p.p.m. nitrate-nitrogen has been recorded. A marked greenness of plants and yield response are evident in these patches.

These observations support the belief that nitrogen supply may be lower than the minimum requirement for vigorous and healthy paspalum growth on the longest utilized and

resown "natural" pastures, despite the relatively high levels of total nitrogen. The extent of nitrogen additions to these soils where legumes have been sod-seeded into the paspalum pasture is considered below.

Methods of Study of Soil Nitrogen Balance

The determination of annual soil nitrogen gains or losses in crop or pasture rotations can be made directly by analysis of the total soil nitrogen level. Unfortunately this method is effective only where the changes in total nitrogen are large in relation to the initial soil nitrogen level and sampling variability is small. It follows that in general, an accurate value can be obtained by this method only from long-term experiments, since the quantity of nitrogen added annually by legumes tends to be masked in all but the most nitrogen-impooverished soils.

Preliminary studies of total nitrogen in the Lismore krasnozems showed that the inherent variability, coupled with high total content, would eliminate any possibility of a meaningful determination of the soil nitrogen increment by the direct method after only one or two years of sod-seeded pasture. An estimate of nitrogen gain based on the amount of nitrogen added by legumes under sod-seeding conditions has been attempted by a method similar to that proposed by Walker, Orchiston, and Adams (1954), and Walker (1956).

In Walker's method, the annual yields of nitrogen in the above-ground components of a mixed legume-grass sward, as compared with a non-legume grass sward, are used to estimate the amount of nitrogen contributed by legumes. It is assumed that all nitrogen in the legume is fixed symbiotically, and that any increase in nitrogen in the associated grass of the mixed sward over the grass alone sward is due to transference from legume to grass. In order to assess the total increment, the assumption is made that the ratio of herbage tops to roots for mature legumes is 3:1, and for mature grass 2:1. Estimates of accretion in rainfall, and of removal due to leaching and gaseous loss etc. are also required to determine the soil nitrogen equilibrium and the time required to reach any intermediate

TABLE 1

Total nitrogen content of soils under pasture in the Richmond Region.

Great Soil Group	% Total N in Surface Soil		No. of Soils Examined
	Range	Avg.	
Krasnozem	0.374-0.708	0.447	30
Podzolic	0.058-0.245	0.117	6
Chocolate	0.226-0.341	0.295	5
Prairie	0.291-0.400	0.327	4
Black Earth	0.172-0.310	0.241	2

nitrogen level. According to Walker, this equilibrium is expressed by the formula, adapted from Jenny (1941):

$$N_E = \frac{k_2}{k_1}$$

where N_E is the equilibrium level of nitrogen; k_1 is that fraction of soil nitrogen which mineralizes each year and is lost by removal in herbage, when cutting for conservation, or through stock grazing the herbage, and by denitrification or leaching;

k_2 is pounds of nitrogen per acre per annum added to the soil from outside sources and accumulating in the organic form.

Experimental Data

Two pasture treatments were established in 1953 on krasnozem soil near Lismore. Paspalum pasture sod-seeded with a mixed-legume component comprised the improved treatment, and the natural paspalum pasture the unimproved treatment. Treatment, sampling methods, and monthly yield figures have been fully reported by Crofts, McGarity, and Rayner (1957), and relevant data at maturity are given in Table 2. In addition to monthly herbage sampling, the soils from each treatment were sampled to a depth of six feet, and ammonium-, nitrate-, and nitrite-nitrogen contents, moisture content, and mineralization values determined. These data provided evidence of the nature of movement of the labile forms of mineral nitrogen.

Over a two-year period no evidence was obtained of any significant leaching of nitrate-nitrogen, the concentration of which was generally less than 1 p.p.m. to a depth of six

feet under both treatments, (McGarity 1958). Ammonium-nitrogen, although present to the extent of 6 to 25 p.p.m. in the profile, was considered too immobile for serious leaching losses; any loss was probably balanced by accretion in rainfall. Other experimental data suggest that denitrification was unlikely under conditions normally encountered in the field under mown swards (McGarity 1958).

Nitrogen Gain or Loss Under Improved Pastures

The simplest calculation of the nitrogen gain is to estimate the amount of nitrogen fixed by the legume from the data in Table 2, using the top:root ratio of 3:1. Thus, the total nitrogen fixed in this way in 1953-1954 and 1954-1955 periods by calculation would be 73 lb and 113 lb respectively. This assumes that none of the legume nitrogen is derived from mineralization of soil nitrogen, but all completely by symbiotic fixation. Although grass growth, associated with legumes, appeared greener, there was no yield evidence of transference of nitrogen from legume to grass during growth of the legumes.

While the above calculation gives an estimate of total nitrogen fixed, losses due to removal of forage must be considered in order to calculate the net return per annum. If the equilibrium equation of Walker is used, and the initial content of soil nitrogen is taken as 10,000 lb per acre 6 in., then k_1 values of 0.0025 and 0.0043 are found for the two seasons. These values represent dry and wet years respectively. The other constant, k_2 , is the net quantity of nitrogen added by legumes and retained per annum, and has

TABLE 2

Yields of nitrogen in herbage tops (lb./ac.) from improved and unimproved pasture.

Season	Legume (C)	Improved		Date	Unimproved	
		Date	Grass (G _i)		Grass (G _u)	Date
1953-1954	54.8	24.11.53	33.6	31.5.54	25.5	31.5.54
1954-1955	85.0	11.10.54	49.7	2.5.55	42.7	2.5.55

been given different values in Table 3. Although objections may be raised to the constancy of the k_1 value used in the equation, since the nitrogen mineralized per annum will be dependent on soil conditions including climate and changes in the C/N ratio induced by residues of clover roots, it does enable an approximate calculation of the equilibrium value for soil nitrogen when cutting of pasture is practised. The time taken for increase (+) or decrease (—) of 0.1 per cent. N in the soil ($\Delta t.1\%N$) from the initial level of 0.500 per cent. N can also be calculated from the data by integration of the formula

$$\frac{dN}{dt} = -k_1N + k_2$$

with respect to time (t), (Table 3).

The effect of grazing is more difficult to assess, and is subject to even greater assumption than the above calculation.

Under New Zealand conditions, Metson and Hurst (1953) were unable to show any difference in nitrogen yields between grazed clover-grass pastures to which a full return of excreta was made, and those to which no return was made. Melville and Sears (1953), however, have reported a 20 per cent. decrease in clover production and a 50 per cent. increase in grass production with grazing. It is also generally considered that 20 per cent. of the nitrogen consumed is retained by the grazing animal, (Walker *et al.* 1954). Using these values of Melville and Sears, and confining consideration to the same yields of clover and grass as in the previous calcu-

TABLE 3

Nitrogen equilibrium in Wollongbar clay loam following sod-seeding of legumes.
Values in lb N/acre

Assumption	Year	Clover Cy*	Grass G _i	Grass G _u	k ₂	k ₁	N _E †	$\Delta t.1\%N$ (years)
All nitrogen in clover due to fixation. Clover retained. Grass harvested at end of the season.	53-54	73.1	33.6	25.5	65.0	.0025	26,000	(+)52
	54-55	113.3	49.7	42.7	106.3	.0043	24,700	(+)33
80% of nitrogen in clover due to fixation. Clover retained. Grass harvested at end of the season.	53-54	58.4	33.6	25.5	50.3	.0025	20,140	(+)89
	54-55	90.6	49.7	42.7	83.6	.0043	19,450	(+)55
All nitrogen in clover due to fixation. Clover harvested. Grass harvested.	53-54	18.3‡	33.6	25.5	10.2	.0025	4,080	(—)165
	54-55	28.3‡	49.7	42.7	21.3	.0043	4,950	(—)116
80% of nitrogen in clover due to fixation. Clover harvested. Grass harvested.	53-54	14.7‡	33.6	25.5	6.6	.0025	2,640	(—)127
	54-55	22.7‡	49.7	42.7	15.7	.0043	3,650	(—)88

* Clover yield—calculated using top:root ratio of 3:1 = Cy.

† Initial level = 10,000 lb./acre 6" = 0.500% N.

‡ Retained in roots = C_r.

lations, an estimate of the gain and loss of nitrogen under dairying conditions has been attempted (Table 4).

The calculations indicate that an increase in nitrogen of approximately 40 to 60 lb per acre per annum may be possible under the improved pasture. This estimate is probably high, since under continuous or rotational grazing losses due to volatilization from urine may be appreciable (Doak 1952), and increased leaching may be expected. Under practical dairying conditions, some further losses of nitrogen may occur where all excreted products are not returned to the pasture, but are voided in bail yards and night paddocks.

There is a possibility also that with the enhanced turnover of nitrogen through return and uptake, more may be retained by the

grazing animal. In this respect it may be possible to produce 4,000 lb of milk per acre per annum from the improved pasture and with other requirements of the dairy cow, some 30 lb per acre per annum of nitrogen might be removed from the pasture. This is of the same order as the calculated values of 19 to 28 lb considered to be retained by the animals as shown in Table 4.

Effect of Improved Pastures on Total Soil Nitrogen

The calculated annual nitrogen increment in the soil beneath pastures can range from net positive to net negative values depending upon the method of utilization employed. Although the methods of calculation are presumptive, they yield results of the correct

TABLE 4

Effect of grazing on gains and losses in sod-seeded pasture. Values as lb N/acre.*

	Improved Clover Grass Tops Roots Tops			Unimproved Grass Tops
1953-1954				
Nitrogen in pasture *	43.7	14.7	50.4	38.3
Nitrogen retained by animals and lost from pasture †	8.7	—	10.3	7.7
Nitrogen gain (+) or loss (—)	+35.0	+14.7	—10.3	—7.7
Total gain (+) or loss (—)		+39.4		—7.7
1954-1955				
Nitrogen in pasture *	62.9	22.7	74.5	64.1
Nitrogen retained by animals and lost from pasture †	12.5	—	14.9	12.9
Nitrogen gain (+) or loss (—)	+50.4	+22.7	—14.9	—12.9
Total gain (+) or loss (—)		+58.2		—12.9

* Calculated using 20% decrease in clover yield and 50% increase in grass yield under grazing.

† Calculated using 20% retention of nitrogen from grazed herbage.

order of magnitude. The estimated fixation of nitrogen under the most favourable conditions (113 lb in 1954-1955 season) is only one fifth of amounts reported in New Zealand (Walker *et al.* 1954). However, the estimated figures of 40 to 60 lb net gain under grazing conditions may be compared with the average annual net increment of 50 lb of nitrogen in legume leys reported by Penman (1949) in Victoria, and gains of 21 lb reported by Purchase, Vincent, and Ward (1949) in New South Wales. Penman was not able to show gains in the first few years, due to slow establishment on previously cultivated soil, and considered that short-term leys were of little value in restoring the total nitrogen level.

On a percentage basis, a 40 to 60 lb annual net gain of nitrogen to Lismore krasnozems would be less than a 1 per cent. increase per annum in the total soil nitrogen content. It follows that short-term improved pastures would be of little value at Lismore in raising soil nitrogen levels or increasing markedly the nitrogen yields of grass.

Over a long term, providing legumes can be retained in the Lismore pastures with the same efficiency as in these experiments, it would take more than 40 years, neglecting differential effects and accepting the most optimistic evaluation, to raise the nitrogen content of the soil from 0.500 per cent. to 0.600 per cent. N under the usual dairying conditions. Even if legume herbage were retained and grass only was cut for hay, a similar length of time would be required for a buildup of 0.1 per cent. N.

Considering how rapidly the nitrogen level may fall under pasture from the original virgin level under rainforest, and how slowly this would be restored, it is evident that from a practical viewpoint sod-seeded pastures at Lismore would be better regarded, in terms of total nitrogen accretion, as fertility maintaining than fertility building. This would guard against the belief that improved pastures of this type offer a means of quickly replenishing the total soil nitrogen level under run-down pastures or cultivated areas in which an even greater depletion of the original nitrogen level could be anticipated.

It is in this latter respect that perhaps the greatest danger of soil nitrogen depletion currently exists, and it is hoped that the present contribution will draw attention to the difficulties involved in rapidly rebuilding the nitrogen in such soils to levels which would enable satisfactory re-establishment of paspalum-dominant pastures.

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Book Review

Diseases of Livestock

By T. G. Hungerford

Angus and Robertson Ltd., Sydney, Fourth Edition, 1959.

By judicious selection from the scientific literature and from his own extensive practical experience Mr. Hungerford has achieved in *Diseases of Livestock* a text-book of consistent excellence. He has included chapters on diseases of sheep, cattle, pigs, dogs, cats, horses and goats; parasitology, deficiency diseases, poisoning, and diseases of animals affecting man. In many diseases limited reference to the scientific literature is included for the reader who requires more detailed information. Diseases of poultry are not included as the author has written a separate book on this subject. An unusual and very useful section lists all the veterinary pharmaceutical preparations which are available in Australia, with dose rates and the names and addresses of the manufacturers. The comprehensive nature of this list is indicated by the fact that it occupies over 50 pages of small type. By itself, this information makes the book a valuable aid for veterinarians and others interested in veterinary medicines.

The whole text is 600 pages of admirable compromise between a summary and a complete treatise on the subject under consideration. It makes a valuable reference book for every sphere of interest in animal disease—stockowners, Agricultural College and University agricultural students, veterinary students and veterinarians. There can be few, if any, animal diseases present in Australia which are not covered in adequate detail, having regard to their importance and to the scientific knowledge of them.

I have not seen a better general veterinary book, either for presentation of authentic information or for selection of subjects; I doubt whether the most severe critic could point to one significant error of omission or commission. This fourth edition of *Diseases of Livestock* is a tribute to the author's industry, descriptive ability and capacity for accurate documentation. The printing and binding are of appropriate excellence.

C. J. R. GORRIE.

Wool Fibre Thickness Frequency Distribution in the Staple: The Proximal Sample Compared with the Whole Staple

In the measurement of fibre thickness of staples, samples may be taken from one level, or from the whole staple. The differences between these two samples and their significance, are of concern in fleece analysis.

If the frequency distribution is to illustrate the variation in thickness of fibre elements produced at any given time by the follicles responsible for the staple, then it should be obtained from a sample taken at a proximal level and preferably where volume growth has been optimal. Goldsworth and Lang (1954) have hinted that fibre elements grown simultaneously may remain juxtaposed in the staple along the greater part of its length, due to entwining of fibres at an early stage of growth. Caution in this regard, has generally prompted the taking of a cross section of the proximal staple, rather than one from a higher level.

By contrast, for many other purposes, preference has been expressed for a 'whole staple' sample, since that must reflect the subjective assessment of any appraiser, whether wool-grower, broker or buyer.

If a staple shows a uniform staple crimp frequency along its length, it is generally assumed that the thickness rate-of-production of the various follicles has been comparatively constant, though this is not necessarily so (Lang 1947). If a staple shows a variable staple crimp along its length, it is assumed that the fibre thickness mean has also changed, though again, this is not necessarily so (Lang 1947).

The opportunity has occurred for comparing proximal and 'whole staple' samples for —

1. 99 Staples in each of which the staple crimp frequency was constant;
2. 87 Staples in each of which the staple crimp frequency was variable (the maximum change in crimp wavelength being approximately 2:1, e.g. 8:16 per inch, or 5:10 per inch).

This has been used to illustrate the differences that might be expected in mean fibre thickness and its variability in the two samples.

The following information was obtained.

Crimp Frequency Constant

A. When the mean fibre thickness values of the proximal staple and the whole staple were compared, there was a correlation of +0.90 with a regression equation of whole staple (x) on proximal staple (y) of

$$x = 0.87y + 3.66$$

For mean thicknesses of the proximal sample below 24 microns (approx.), the mean thickness of the whole staple tended to be the higher, whereas above this value to 34 microns, the upper limit of the group, the mean thicknesses of proximal and whole staple were similar.

B. Coefficients of variation (%) of fibre thickness of proximal and whole staple showed a correlation coefficient of +0.76 with a regression equation for whole staple (x) on proximal sample (y) of

$$x = 0.93y + 3.51$$

For all the values of proximal coefficient of variation, the relevant values for the whole staple tended to be higher.

Crimp Frequency Variable

A. The mean thicknesses of proximal and whole staple gave a correlation coefficient of +0.78 with a regression equation of whole staple (x) on distal sample (y) of

$$x = 0.88y + 4.65$$

from which it is seen that the whole staple values tend to be higher over the range under notice (15-34 microns).

B. Coefficients of variation (%) of fibre thickness of proximal and whole staple showed a correlation coefficient of +0.73 with a regression equation of whole staple (x) on distal sample (y) of

$$x = 0.91y + 6.5$$

showing that the coefficients of variation

of the whole staple thickness tend to be higher than those for the proximal.

In summary, where crimp frequency is constant throughout the staple, values of mean fibre thickness and its coefficient of variation, are similar in proximal and whole staple samples. When the staple crimp frequency is variable the differences are distinctly greater. This emphasises that in the former case, in practice, there is approximate equivalence, whereas in the latter, the whole staple tends to be different in mean thickness and greater in coefficient of variation.

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Residual Response to Urea Fertilization

Nitrogen fertilization of wheat in relation to skeleton weed (*Chondrilla juncea* L.) is being studied as part of an overall skeleton weed/wheat investigation.

Semi-drought conditions current in 1957 resulted in very low yields. However, application of nitrogen, as urea, led to a small but significant increase in yield. In 1958 the experimental area was sown to oats. Shortly after crop establishment it became evident that treatment differentials applied in 1957 were still operative. These differences were followed through to harvest. Straw and grain

TABLE 1

Effect on yield of cereals in successive years of applying nitrogen as urea in the first cropping year.

Treatment	1957 Koala wheat			1958 Burke oats	
	Grain	Straw and chaff	Total Nitrogen Uptake	Grain	Straw and chaff
No Nitrogen	cwt/acre 4.7	cwt/acre 8.3	lb/acre 16.7	cwt/acre 27.8	cwt/acre 47.1
Nitrogen applied average all dressings	5.5	9.8	20.0	31.8	70.8
Min. Sig. Dif. P = .05	0.3	1.3	2.9	4.0	9.9

TABLE 2

Rainfall at experiment site 1957/58.

	Jan.	Feb.	Mar.	Apr.	May	Jne	Jly	Aug.	Sep.	Oct.	Nov.	Dec.
1957	12	216	114	106	9	178	259	85	53	83	107	262
1958	125	98	186	58	143	91	217	190	239	231	184	117

yields, together with nitrogen uptake by the crop in 1957 are given in Table 1.

On the average only 3 lb per acre of fertilizer nitrogen was utilized by the 1957 crop, which left substantial residues of the 20 lb and 40 lb per acre applications of nitrogen as a carry over into 1958. Recent reports suggest that the commonly held concept of rapid nitrogen loss by leaching and denitrification must be related to seasonal conditions and the fertilizer employed. Broadbent, Hill and Tyler (1958) show a slower downward movement of urea through soil than of NO_3^- and report a rapid nitrification of the fertilizer during incubation at field moisture capacity and 24°C . Gasser (1958) shows that the concentration of mineral nitrogen in the surface soil, following the application of nitrogenous manures remains high until "*persistent and prolonged rainfall*" (writer's italics) causes leaching. At least 20 weeks were required for complete nitrification of applied nitrogen under the conditions of Gasser's experiment. More recently White and Pesek (1959) reported that from one third to one half of nitrogen applied at sowing time remained at the end of the corn season, chiefly as NO_3^- . As late as 12 months from sowing the NO_3^- was located in the 6-21 inch layer the amount of precipitation influencing the depth of penetration.

The implication that an excess of moisture is required for leaching is quite clear and provides the key to the results herein reported. Not only were monthly rainfall totals at the experimental site (Table 2.) for the twelve months ended July, 1958 relatively light, but the average recording per day of rain did not exceed 18 points; falls of 50 points were rare. Heavy rain occurred only in December, 1957 when 262 points were recorded in a 48 hour period. Under these circumstances it is possible that nitrification rate would be reduced and movement of NO_3^- through the soil curtailed.

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Bacterial Blight of Cotton in North Western Australia

The cotton disease caused by *Xanthomonas malvacearum* (E.F. Sm.) Dawson, and known in its various manifestations as seedling blight, angular leaf spot, vein blight, blackarm, bacterial ball rot and bacterial blight has been recorded in practically all cotton growing areas. In some of them, particularly in Africa, it is responsible for considerable yield losses. The disease is not considered a serious one in Queensland although it occurs there.

Cotton has been grown experimentally at the Kimberley Research Station, W.A., since 1947. Often the symptoms of bacterial blight have been observed but until the 1958-59 season the damage caused has been slight and the disease has never attained epidemic proportions.

Two separate outbreaks of bacterial blight occurred in the 1958-59 season. The first, in March, 1959, was confined to a few plots of a trial planted in December. It began only six weeks before the crop was ready for the first picking. Although stems and bolls as well as leaves showed symptoms of infection, the severity of the attack was moderate.

The second outbreak occurred after a cyclonic storm in early April when torrential rains (over 20 in. in three days) and high winds created conditions particularly favourable to the spreading of infection. All cotton trials grown on Cununurra clay were affected, the severity depending on varietal suscep-

tibility. A small trial grown some distance away on Ord sandy loam escaped serious attack.

Effect on Yields

The yields of plots which were infected during the earlier attack were compared with yields of disease-free plots. The moderate attack occurring late in crop development had no significant effect on the yield of the first pick or the total yield (Table 1). It did, however, significantly affect the yield of the second pick. It was observed that the diseased bolls tended to open prematurely. This undoubtedly affected the fibre quality, and, as confirmed by boll counts, lowered the number of bolls remaining on the diseased plants after the first pick, thus causing the reduction in yield.

Because all plots were severely affected by the later attack, no quantitative assessment was made on a yield basis. However field observations showed that with the exception of more resistant varieties the damage was considerable. Plots planted in late January and February and defoliated by the attack in April recovered well during May. Fresh leaves and bolls were produced until the onset of cool weather late in the month.

Varietal Differences in Susceptibility

During the April epidemic large differences in susceptibility were observed on 65 varieties included in a number of trials. A grading of from one (immune) to five (highly susceptible) was used to assess the severity of the attack.

TABLE 1

Mean yields of disease free and infected plots of D & PL 15 and Miller 43-9-0 varieties.

	D & PL 15			Miller 43-9-0		
	First pick (lb/ac)	Second pick (lb/ac)	Total (lb/ac)	First pick (lb/ac)	Second pick (lb/ac)	Total (lb/ac)
Healthy	1,581	298	1,879	942	272	1,210
Diseased	1,744	149	1,893	839	82	921
Difference	NS	$P \leq .05$	NS	NS	$P \leq .01$	NS

The records show that:

- *Gossypium barbadense* varieties with the exception of those in which resistance genes had been incorporated were very susceptible (Grade 5).
- Only varieties with B₂, B₃, or B₂ B₃ B₆ genes (Knight 1946) showed complete or nearly complete immunity (Grade 1). Those varieties with only one major gene resistance, B₂, were more susceptible (Grade 2 and 3).
- *G. hirsutum* varieties, were, in general, less susceptible than the genetically non-resistant *G. barbadense* varieties. The great majority were graded 1 to 3.

Conclusion

Bacterial blight is likely to be an ever present disease of commercial cotton growing in north-western Australia, and may be serious in wetter years. Prevention by seed dressing and field sanitation in this area is likely to be insufficient and costly. Although the break-

down of resistance conferred by major genes has been reported from the Sudan (Rose *et al.* 1958), India and the United States of America (S. C. Harland personal communication), breeding probably still offers the best means of control.

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The Magnesium Supplying Power of Glazed Porcelain Pots

Barrow (1957) has drawn attention to the significance of sulphur impurities in glazed porcelain pot material as a source of error in pot experiments. Chemical analysis of pulverised pot material indicated that most of the sulphur was derived from absorption during previous experiments. This absorption had been facilitated by the crazing which had occurred on the internal glazed surfaces of a number of the pots.

Evidence derived from a pot experiment carried out by the author in 1955, designed to

examine potassium-magnesium interrelationships in subterranean clover, has suggested that glazed porcelain pots can supply the magnesium requirements of this species from the magnesium-rich material which is used in manufacture of the pots. In this experiment a batch of new, and to all appearances uncrazed pots was used. As earlier attempts to demonstrate magnesium deficiency in subterranean clover grown in such pots had proved inconclusive even under nutritional conditions which were designed to demonstrate the deficiency (Rossiter 1951), it was suspected that the plant species grown in porcelain pots obtained their magnesium supply from the pot material.

Chemical analysis revealed that the pots used in the 1955 experiment each contained approximately 2 g of magnesium. This magnesium was largely present as the mineral

talc (hydrous magnesium silicate): one of the substances used in the manufacture of the pots. To obviate the possibility of plants obtaining magnesium from this source all pots in the experiment were coated interiorly with a film of "Plastacoat"—a special plastic anti-corrosive paint. Additional uncoated pots were carried with the experiment. Statistically significant yield reductions were recorded for the no-magnesium treatments at three harvest dates, namely days 39, 60 and 88 after germination. Mean transformation values for the no-magnesium and magnesium treatments were as follows:—

<i>Treatment</i>	<i>Geometric Mean</i>
0 lb./ac. MgSO_4	1.573
84 lb./ac. MgSO_4	2.087

The difference between the geometric means was significant at the 0.1 per cent. level. Visual leaf symptoms of magnesium deficiency similar to those described and illustrated by Millikan (1953) appeared within 3-8 weeks after germination. No yield reductions or visual symptoms occurred on plants grown in the uncoated pots.

Although it would be expected that the availability of the magnesium from the pot material

would be low, there is strong presumptive evidence from the experimental work outlined that the plant species obtained sufficient magnesium from this source to satisfy its requirements. This evidence supports the contention made by Barrow that rigid precautions are necessary to prevent contamination from the pot and hence the introduction of an additional source of error in plant nutrition experiments utilizing glazed porcelain pots.

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The Effect of Supplementation with Urea and Molasses on the Liveweight, Appetite and Wool Growth of Sheep

Williams, *et al.* (1959) have reported that the supplementation of a low protein straw diet with urea and molasses increased the food intake of sheep and reduced their loss of weight by about 50 per cent. These results were obtained with daily intakes of 18 g urea and 72 g molasses per sheep. The present experiment

was planned to investigate the effect of feeding higher levels of urea, and of feeding molasses without urea.

Procedure

Sixty-four full-mouthed Corriedale wethers were divided into eight equally sized groups and kept in yards each of which measured approximately 0.05 acres. These yards were frequently rotary hoed and kept entirely free of plant growth. The following four treatments were used, each treatment being replicated twice.

Treatment 1—Basal diet of oaten straw (crude protein 3.0 per cent.), which had been

hammer-milled through a $\frac{3}{4}$ inch screen and which was fed *ad libitum*.

Treatment 2—Basal diet as in treatment 1 plus 240 g molasses per sheep per day.

Treatment 3—Basal diet as in treatment 1 plus 240 g molasses and 15 g urea per sheep per day.

Treatment 4—Basal diet as in treatment 1 plus 240 g molasses and 30 g urea per sheep per day.

The sheep were offered weighed amounts of food in troughs every morning, the residues being weighed the following morning. The urea and molasses were dissolved in water and mixed thoroughly with the chopped straw. The amount of water used for the solution was such that the feed offered was about 50 per cent. moisture by weight. The sheep were weighed weekly and estimates of wool growth were made by clipping a mid-side sample ($10 \times 15 \text{ cm}^2$) on each sheep at the beginning and end of the seven week experimental period.

Results

Liveweight. Changes in liveweight are shown in Figure 1. The sheep fed straw only, or straw plus molasses, showed a steady decline in weight of more than 2 lb per sheep per week. Those fed the higher level of urea showed a slight increase in liveweight, and those on the lower level maintained weight. Between the treatments with urea (3 and 4) there was

no significant difference nor was there a significant difference between the treatments without urea (1 and 2). However, between each of the treatments with urea (3 and 4) and each of those without (1 and 2), the differences were all significant at the 5 per cent. level and often at the 1 per cent. level.

Food Intake. The differences in straw intake between the four treatments have been analysed statistically and are shown in Table 1.

Wool Production. The differences in wool yield from the mid-side patches due to the four treatments have also been analysed statistically and are shown in Table 2.

Discussion

The feeding of a urea and molasses supplement to sheep on a straw diet increased the intake of straw by approximately 45 per cent. and maintained the liveweight of the sheep when, without the supplement, there was a decline of about 2 lb per sheep per week. There was also a consistent, although not always a statistically significant, increase in wool yield from the supplemented sheep. These effects were not produced by supplementation with molasses only, nor were they significantly changed by increasing the amount of urea used from 15 g to 30 g per sheep per day. All the supplemented sheep ap-

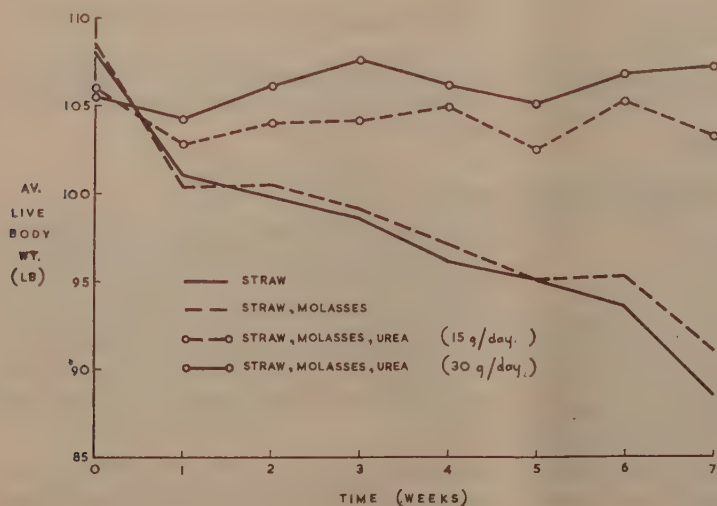


Figure 1—Changes in the average live body weight of sheep in the four treatments over a period of seven weeks.

Differences in food intakes between treatments.

	Treatment			
	1	2	3	4
Total straw intake (lb)*	1131.2	1132.6	1622.6	1579.9
Av. weekly intake (lb)*	161.6	161.8	231.8	225.7
Difference between control and test group (lb)	0	0.2	70.2	64.1
Difference (lb) required for significance $P < 0.01$	47.7			

*For total of 16 sheep per treatment.

TABLE 2

Differences between treatments in average wool production during the seven week period.

	1	Treatment 2	3	4
Av. yield dry scoured wool per mid-side sample (g)	3.1	3.3	3.9	3.7
Differences in av. yield (g)	0	+0.2	+0.8	+0.6
Differences required for significance (g) } $P < 0.05$	0.62			
} $P < 0.01$	0.84			

peared in good health throughout and no signs of urea toxicity were observed.

These results are in agreement with those reported by Williams *et al.* (1959) and similar findings have also been published by Morris (1958). It is suggested that where, as in this experiment, animals are fed on roughage diets low in protein content, the use of a urea and molasses supplement, sprayed on to the dry material, may be an easy and economic method of increasing food intake and, in consequence, the level of animal production.

Acknowledgments

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mittee for the grant that made this work possible.

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Slide Rule for Judging and Grading Beef Carcasses

In an earlier publication the relationship between length and weight of a range of 80 randomly selected Australian beef carcasses, of two export grades, was shown (Yeates 1952). A description was given of how this relationship could be used to define individual carcasses quantitatively, in terms of a fleshing index. Tayler (1958) has since used the index

and has reported favourably on its general discriminatory value.

Although the index was found to provide a useful overall description of carcass "meatiness" (i.e. the combined development of muscle and fat), it was recognized that precise definition would require separate consideration of fat status. Recent studies (Yeates and Bungey, unpublished data) indicate a way in which fleshing indices may, where necessary, be corrected for over-fatness.

The purpose of the present paper is to describe a slide-rule which measures fleshing index and also incorporates a cursor for applying appropriate corrections for over-fatness, based on the above-mentioned studies.

Description

On the main body of the slide-rule two scales are inscribed, the lower being carcass length and the upper, hot dressed weight. By sliding the zero mark of a centre strip, marked off either side of its mid-point in pounds weight, to the point representing the length of any carcass, the fleshing index of the carcass may at once be read off, providing its weight is known. The index will be positive and read to the right if the carcass is well fleshed; conversely, negative and read to the left, if the carcass is poorly fleshed.

Correction for over-fatness, if necessary, is then applied. The base-line of the cursor is moved to the "provisional" or primary fleshing index value and the appropriate deduction made according to the measured fat status of the particular over-fat carcass. This then gives the final, or net fleshing index.

No correction is made for under-fatness which is, in a sense, self-correcting because of its likely association with low carcass weight. On the other hand, if a carcass achieves a high index despite a lack of fat, this denotes specially superior muscle development. To penalise such a carcass seems artificial; rather it should be diverted to a class of low-fat carcasses where its special attributes will be appreciated.

Measurements

Carcass length is measured on the full side of beef, using a steel tape marked in centimetres.

The tape is drawn tightly along a direct line between the anterior edge of the pubic bone and the mid-point of the junction of the bodies of the last cervical and first thoracic vertebrae.

Weight of the side, in pounds, is required. This is routinely available under existing abattoir procedures. The sides pass over the scales on their way from the slaughter floor to the chilling room.

Fat status is measured, following chilling, and when the sides are quartered, on the cut surface between the 10th and 11th ribs. (If for certain trades carcasses are quartered at other than the 10th-11th rib, a check would need to be made that the system as outlined below would still apply; slight modification might be necessary.)

Fat status is defined as the ratio of lean meat to the mean of two measurements of fat thickness, viz:— $W/\text{mean of } X \text{ and } Y$ (see Figure 1).

X is measured at the point where the lateral edge of the oval-shaped "Eye" or Longissimus dorsi muscle approaches most closely to the outside surface of the carcass. Y is measured considerably nearer to the chine, immediately above and halfway across the Multifidus muscle. W is the maximum

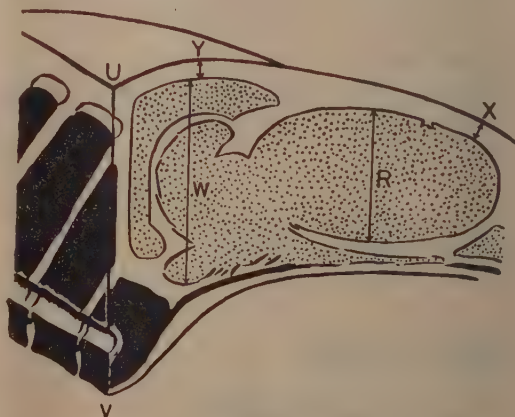


FIGURE 1—Diagram of posterior end of fore quarter showing location of points concerned in the measurement of "fat status". (Disregard dimension R)—From Aust. J. Agric. Res. Vol. 3, No. 1, p. 73.



FIGURE 2—Illustration of method by which fat correction scale was evolved.

This standard 3-rib joint weighed 21 lb 10 oz. Its lean : fat ratio was 3.4. 6 lb 6 oz of fat was pared from it to bring the ratio to 7, i.e. to the maximum "acceptable" degree of fatness. This amount of fat trimming represented a theoretical equivalent of 218 lb for the whole carcass.

depth of lean meat measured in a line parallel with the chine (UV).

Explanation

Primary fleshing index. The principle involved in this index has previously been explained (Yeates 1952). The regression on which it is based relates to carcasses within the weight range 500-1,100 lb. Further data have since been obtained to extend the lower limit of weight range to 200 lb. This extension has been incorporated in the slide-rule.

Fat Status. A lean to fat ratio of 7 (i.e. $W/\text{Mean of } X \text{ and } Y = 7$) has been chosen (Yeates and Bungey, unpublished data) as the upper limit of acceptable fatness; hence 7 represents the base-line on the slide-rule cursor. Carcasses fatter than this, (that is

those with a ratio less than 7), are corrected by a deduction from their primary fleshing index. The deduction increases with increasing fatness: it represents the theoretical total amount, in pounds, by which the carcass is over-fat. The method by which the scale of corrections was derived is shown in Figure 2.

Fat in excess of that representing ratio 7 was pared from test 3-rib joints of over-fat carcasses. The weight of this excess fat was then converted to an estimate of its whole-carcass equivalent, using a modification of Hankins and Howe's (1946) sample joint technique. For this purpose our regression was derived from 29 carcasses, typical of a broad range of the Australian beef trade. The paring technique is illustrated in Figure 2.

Discussion

The slide-rule was recently used in judging a carcass competition at Tenterfield, N.S.W. By request, all 17 entries had to be ranked in order of merit. The task was completed in a little over half an hour and the result was to the complete satisfaction of all concerned. The instrument should have wide application for competition judging.

It should also be useful in distinguishing growth differences in groups of experimental slaughter cattle. Results should lend themselves well to statistical treatment.

The quickness with which the instrument can be used suggests that it might also have a place in commercial grading practice. There would be advantages in adopting an objective

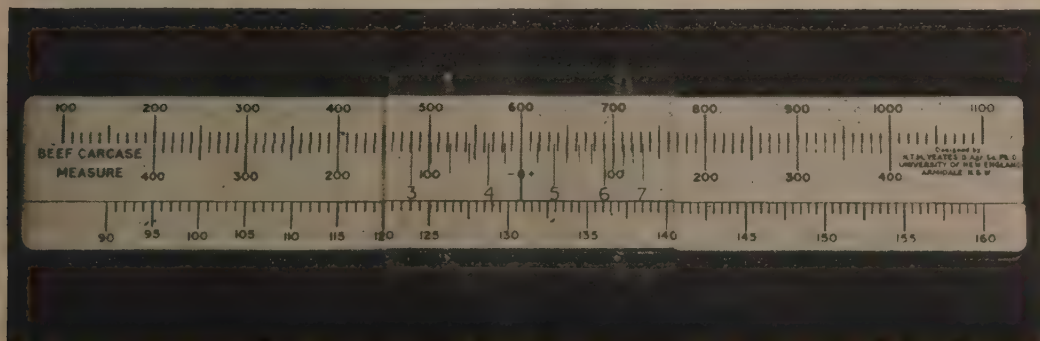


Figure 3—The Slide Rule.

system of grading. Further, as this particular system favours carcasses yielding high proportions of lean meat, it could also serve as a sound basis on which to pay producers for their cattle.

A full report of the instrument, illustrated in Figure 3, will be published later, when more data relating to the cursor have been assembled and statistically analysed. This preliminary report is to meet requests for a description of the slide-rule. Those interested in testing its suitability for their own needs are invited to apply to the Registrar of the University of New England, Armidale, N.S.W., with a view to arranging supply. Early use of the instrument by investigators having different requirements should indicate whether any modifications are needed for specific purposes. Such modifications, if desirable, should apply only to the cursor. Alteration of this might occasionally be necessary in

any case, to meet the needs of changing public taste regarding fat thickness. Some markets, regions or individual investigators might require a different cursor, or even several interchangeable ones any of which would fit the standard frame on the instrument.

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Inhibition of Rooting by Maleic Hydrazide

One of the many effects described for maleic hydrazide (MH) is reduction of root growth (Naylor and Davis 1950). However no reference to the effect of MH on the rooting of cuttings has been found except a brief mention of reduced rooting of citron cuttings treated with 1 p.p.m. MH (Rodriguez and Inforzato 1956). In an experiment designed to test the effect of MH on apical dominance of sultana cuttings it was noted that treated cuttings did not root. This effect was investigated in more detail with the results described here.

Two experiments were laid out. Each consisted of five treatments, namely MH at 200, 50, 12, and 3 p.p.m., and tap water, each treatment being applied to ten cuttings. For

the first experiment, which was started on November 16, 1958, two-bud cuttings from the previous season with their lower bud scraped off were used. In the second experiment, started on March 16, 1959, current season's three-bud cuttings with the lower two buds removed were used. All cuttings were planted in vermiculite and kept in a glasshouse. As shoot growth is very vigorous in November and December bottom heat of 75 ° F was supplied in the first experiment to favour root growth. This was not necessary in the second experiment because in March and April grape buds are in deep dormancy and no measures were taken to obtain shoot growth.

In the first experiment MH was applied directly to the cuttings, by placing their basal end in the liquid for 24 hours before planting. After 40 days, roots and shoots were weighed and shoot-lengths measured. The results are shown in Table 1.

TABLE 1

Root and shoot growth of sultana cuttings after standing in maleic hydrazide for 24 hours.

Treatment p.p.m.	* Number cuttings rooted	Mean root weight g	Number shoots	Mean shoot weight g	Mean shoot length cm
200	1	0.05	7	0.61	20.0
50	10	0.99	10	1.32	31.3
12	10	2.05	10	1.89	42.9
3	10	2.75	10	1.98	42.8
0	10	4.85	10	2.83	54.7
Min. Sig. Dif.	$P \geq .01$	1.73 †		0.88	14.0

* Each treatment was applied to ten cuttings.

† The treatment 200 p.p.m. was excluded from the statistical analysis.

Although only one of the cuttings treated with 200 p.p.m. MH had developed any roots eight more had formed some callus. It is therefore possible that they would eventually have rooted but it is doubtful whether shoot growth could have survived until then.

In the second experiment MH was applied to the medium. Immediately before planting the cuttings 50 ml of liquid was poured into each container — the run-off was collected and measured. After three months the amount of root growth was determined by counting the number of roots, measuring their lengths, and weighing them. The results are given in Table 2.

None of the differences between 3 p.p.m. and 0 p.p.m. are significant. In the 3 p.p.m.

treatment there was no correlation between the amount of solution retained in the tube and root development of the cuttings.

With cereal seedlings, Naylor and Davis (1950) found that root development was less inhibited than top development when 20 ml MH was sprayed on at concentrations of 500 p.p.m. and stronger. From the data presented here it appears that root initiation on cuttings is severely restricted even at much lower concentrations irrespective of whether MH is applied directly to the cutting or through the soil.

Acknowledgment

Thanks are due to Mr. A. J. Antcliff for suggesting the work and to Mr. P. B. Smith for propagating the cuttings.

TABLE 2.

Root growth of sultana cuttings in medium treated with maleic hydrazide.

Treatment p.p.m.	* Number cuttings rooted	Mean number of roots per cutting	Mean root length per cutting cm	Mean root weight per cutting g
200	0	0	0	0
50	0	0	0	0
12	5	6.6	6.0	0.09
3	10	20.4	43.4	0.75
0	10	20.0	40.2	0.79

* Each treatment was applied to ten cuttings.

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The Effect of an Autumn Application of Nitrogenous Fertilizer to Irrigated Pasture on the Production of Grazing Dairy Cows

It is debatable whether, at the present time, the use of nitrogenous fertilizers for increasing pasture growth on the dairy farm is justified economically by the resulting increased income from milk or butter fat. Experimental information on this question is needed.

An experiment was carried out at the State Research Farm, Werribee, in the autumn of 1958, in which the response to a nitrogenous fertilizer was measured in terms of the milk production of grazing dairy cows.

Experimental

Two matched groups each of nine milking cows were rotationally grazed on an irrigated pasture during the autumn of 1958. The pasture had been established for about forty years and consisted of approximately 65 per cent. graminaceous species (mainly *Lolium perenne*) and 35 per cent. leguminous species (mainly *Trifolium repens*). A uniform area of nine acres was divided into ten equal paddocks. For the purposes of this experiment four of these paddocks were grazed for five days each by each group of cows. Each such twenty-day cycle was separated from the next

by a five-day grazing by each group of the fifth, non-experimental, paddocks. Two of the group A paddocks were dressed with urea at the rate of 150 lb N per acre, as soon as the cows had finished grazing them on March 17 and 22. On March 27 and April 1, two of the group B paddocks were similarly treated. The experiment began on April 1. Thus the group A cows spent the first two five-day periods of each cycle on nitrogen treated pasture and the last two on untreated pasture. The group B cows were grazed in the reverse manner. During the first grazing cycle all the cows ate only pasture, during the second cycle a daily supplement of 11 lb of silage dry matter was given to each animal, and in the third cycle this was increased to 20 lb of silage dry matter per animal. This increase in the ration of silage resulted in a rise in milk production of all cows in the last cycle.

The only other fertilizer used on the experimental area was superphosphate applied at a uniform rate of 368 lb per acre in February.

Results

The mean milk production per cow for each ten day period during the first, second and third grazing cycles is shown in Table 1.

The mean difference between treatments, as measured by the milk production during the first and second cycles was 7.6 per cent. of the production from the untreated area and this difference (9.6 lb per cow per 10 days) was significant at the 1 per cent. level. There was no difference in the butter fat or total solids content of the milk produced from either

TABLE 1

Milk production per cow per 10 days on pasture treated (N) and untreated (O) with urea fertilizer at a rate of 150 lb N per acre.

Group	Milk yield per cow per 10 days (lb)					
	N	Cycle 1 O	N	Cycle 2 O	N	Cycle 3 O
A	186.5	147.5	132.6	111.0	135.3	129.0
B	126.8	139.4	101.0	110.6	127.7	134.1
Mean	156.5	143.5	116.8	110.8	131.5	131.6
Difference %	+9.2		+5.4		0	

treatment. Also there was no difference in the milk production from the treated and untreated paddocks during the following spring.

In each grazing cycle, the production of the cows in group B was consistently higher on the untreated pasture, because of the normal decline in lactation with time; this group grazing the treated pasture at the end

of each cycle. The statistical analyses were computed from the pooled production records of both groups for each cycle.

An estimate of the weight of herbage available in each paddock immediately before the grazings of the first cycle (i.e. 20 days after treatment) was obtained by weighing the herbage cut to ground level from ten random sampling sites of 9.6 sq. ft. in each paddock.

TABLE 2

Weight and composition of the available herbage organic matter in four treated (N.1-4) and four untreated (O.1-4) paddocks, immediately before the grazings of the first cycle.

Paddock	Weight and composition of available herbage organic matter			
	Weight lb/acre	C.V. %	Crude Protein %	Crude Fibre %
N.1	1422	15.8	31.8	20.6
O.1	1440	19.4	24.0	23.6
N.2	1008	19.0	26.0	19.8
O.2	1126	16.6	30.5	19.3
N.3	988	25.8	30.3	19.3
O.3	839	18.8	29.2	18.6
N.4	1315	22.4	30.8	20.0
O.4	1260	21.7	24.7	21.3
Mean N	1186		29.7	19.9
Mean O	1166		27.1	20.7

Dry matter determinations and chemical analyses were done on subsamples.

The results of these measurements are shown in Table 2.

There was no measurable difference in herbage production between the two treatments. However, there was a trend towards a higher crude protein content in the herbage from the fertilized paddocks.

Discussion

Although the application of the nitrogenous fertilizers did not result in an apparent increase in herbage production, the cows produced significantly more milk when grazing the treated areas. It is unlikely that an increased protein content of the treated herbage could account for the increased production of milk, although it is possible that undefined changes in the chemical composition of the treated herbage could have either increased its net energy value, or improved its palatability so that the resulting increase in herbage intake could have caused the increased production of milk.

The failure to obtain a measurable increase in herbage production by an application of 150 lb of nitrogen per acre may have been due to the age and nature of the pastures used. The accumulation of nitrogen could have been such that this nutrient was no longer limiting to pasture growth.

Since, however, the milk yield difference

between the cows when grazing treated and untreated pasture was only 9.2 per cent. even in the first cycle of grazing, it remains a possibility that a difference of this magnitude did in fact exist in the levels of herbage production but that the quadrat analysis technique did not show it. It is clear therefore that in this type of study the response in terms of milk production to fertilizer treatment is more accurately assessed than the response in terms of pasture yield. In addition the response in terms of animal production is needed before an economic assessment of the value of fertilizer treatments can be made.

Acknowledgements

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Weather Damage to Exposed Hay Bales

If hay bales are to be left in the field the simplest procedure is to let them lie where they fall from the baler. However, some extra work positioning them to reduce wetting during rainy spells might be worthwhile. For example,

stooking of bales could reasonably be expected to help in shedding rain. The question also arises of whether single bales should be left with the cut face to the top, to the side or to the ground.

During the 1957-58 and 1958-59 seasons, exposure trials were carried out at Highett, Victoria, to compare the weather damage to the various faces of rectangular and round bales left exposed in different ways.

Materials and Methods

Bales for the trials were obtained from perennial ryegrass-white clover crops baled in early December. In one of the trials, ten round bales and thirty rectangular bales were exposed singly on the stubble of a recently mown hay crop. The rectangular bales were exposed ten in each of three positions—the cut face to the top, to the side and to the ground. Half the bales were examined after ten weeks exposure (involving 3.6 in. of rain) and the remainder after sixteen weeks exposure (6.0 in. of rain).

In the second trial 72 bales, both rectangular and round, were exposed. Plastic covers, just large enough to prevent wetting of the top face, were placed on some bales while other bales rested on slatted wooden trays four inches above the ground or on individual plastic sheets. Further bales were placed in simple three bale stooks, those of rectangular bales consisting of two bales resting on a single long edge and leaning against each other with a third bale along the V formed by the two lower bales. Exposure in this trial was for eight months during which there were 11.2 in. of rain. For comparison, similar bales were stored in a hayshed in which they were completely protected from weather.

Exposed bales were weighed periodically, usually before and after rain. At the end of the exposure periods, they were opened and their moisture contents determined to permit estimations of losses of dry matter during exposure. Material damaged by weather and mould was separated and samples for chemical analysis taken from the remaining well preserved material.

Results

Moisture Changes during Exposure

Table 1 records weight increases during wet periods as the number of lb per 100 lb of cured hay, i.e. hay containing 25 per cent. moisture.

In these trials, which were on well drained areas, resting bales on slatted trays had little effect on the amount of water absorbed during wet periods. On the other hand, plastic top

covers greatly decreased the amount of wetting.

With bales resting on plastic sheets water ran down the sides of the bales and entered between the bales and the plastic even though the sheets were slightly smaller than the base area of the bales.

Rectangular bales exposed singly with no protection took up most water when the cut face was at the top and least water when the cut face was to the side. Placing the cut face to the side has the disadvantage that it leaves the bands in contact with the ground and rotting may cause breakage if handling becomes necessary. The sides of the bales facing the prevailing rains took up more moisture than the lee sides.

Single round bales shed water better than single rectangular bales but this superiority was considerably reduced by stooking the rectangular bales. Stooking was a definite advantage with the rectangular bales but of no advantage with the round bales. Stooking did not hasten curing during the three weeks between baling and the first rain—all bales lost approximately 7 lb weight. The main point of stooking is thus to promote shedding of rain.

TABLE 1

Moisture absorbed per wet period—expressed as lb per 100 lb of cured hay.*

Treatment	Round Bales	Rectangular Bales with Cut Face to:		
		Top	Side	Ground
Fully Exposed	2.1	8.3	5.9	6.4
Plastic Sheet on top	0.6	2.1	1.9	2.1
On Slatted Tray	2.8	7.3	5.1	5.3
On Plastic Sheet	4.8	7.6	11.0	11.3
Stooked (av. of 3 bales)	2.9		4.3	

* Average rain per wet period was 1.9 in.

The bales that took up most water during wet periods lost most during dry periods. This does not lessen the disadvantages of higher moisture uptake since moulding can proceed quickly in wet bales and, furthermore, the wetter bales might be subjected to more rain before they have had time to dry out.

Losses, Weather Damage and Moulding during Exposure

Table 2 summarises the losses occurring during the long term (8 months) exposure. Corresponding losses from bales stored in the hayshed were 3.7 per cent. Greater wetting during rainy periods was usually reflected in greater damage to the exposed bales.

Covering bales gave larger savings than raising them off the ground. Losses from bales placed on plastic sheets were high, indicating that any support for preventing contact with the ground must be slatted or of some similar construction which permits free draining away of rain water. Single round bales suffered less damage and loss than single rectangular bales. There was no advantage in

stooking round bales but stooking rectangular bales greatly decreased losses. Single round bales were thus only slightly superior to stooked rectangular bales.

The superiority of round bales over single rectangular bales was less marked in the shorter term exposures. After ten weeks exposure, total losses from round bales and from rectangular bales with cut faces to top, side or ground were 4, 13, 6 and 7 per cent., respectively, compared with loss of 3 per cent. from bales stored under cover. The advantage of placing the cut face to the side rather than to the ground, although small, confirms the earlier observation that this position results in less wetting during rain.

The findings are in accord with those of Greenhill (1957) but only partly in accord with those of Simmons (1958, and unpublished data) who recommended placing the cut face to the ground. The baler used in the present trials cut a face to the side of the bale chamber whereas Simmons' baler cut the top face. With the latter type, the face directly

TABLE 2

Hay losses during eight months exposure—expressed as lb per 100 lb of cured hay exposed.

Treatment	Lost during Exposure Damaged by Weather and Mould Total Loss			Lost during Exposure Damaged by Weather and Mould Total Loss			Lost during Exposure Damaged by Weather and Mould Total Loss		
	Round Bales			Rectangular Bales with Cut Face to Top			Rectangular Bales with Cut Face to Side		
Fully exposed	5.7	5.5	11.2	11.9	25.3	37.2*	9.0	16.2	25.2*
Plastic Sheet on Top	2.2	1.5	3.7	6.3	4.6	10.9	5.6	4.4	10.0
On Slatted Tray	3.1	2.0	5.1	8.9	8.9	17.8	4.7	7.0	11.7
On Plastic Sheet	9.6	12.1	21.7	14.1	34.7	48.8*	14.5	41.1	55.6*
	Stooks of 3 Round Bales			Stooks of 3 Rectangular Bales					
Top Bales	6.4	3.7	10.1†	6.2	4.8	11.0†			
Stooked Bottom Bales	5.7	9.8	15.5	8.2	6.8	15.0			

* High losses due largely to partial collapse of bales.

† Average loss for each stook bale—
rectangular bales = 13.7
round bales = 13.7

TABLE 3

Composition of hay after eight months exposure—expressed as lb dry weight per 100 lb dry weight of hay exposed.

	Crude Protein	Ash	Crude Fat	Crude Fibre	Soluble Carbohydrate
Single Round Bales	11.5	6.4	2.7	26.0	42.2
Stooked Rectangular Bales	10.9	6.3	2.5	26.0	40.6

opposite the cut face is partly sealed by loose material from the bottom of the bale chamber and this may provide some protection when uppermost, that is when the cut face is in contact with the ground.

Changes of Chemical Composition

A comparison was made of changes in chemical composition of the round bales exposed singly and the rectangular bales exposed in stooks. Table 3 indicates that the small differences in overall loss between the two types of bales was due mainly to a greater loss of soluble carbohydrates from the rectangular bales.

Discussions

Leaving baled hay exposed in the field for weeks or months after baling certainly results in greater loss and damage than storage in a hayshed. However, with some extra effort, losses from exposed bales may be greatly reduced and leaving bales exposed for four months or even longer, depending on the rainfall, might often be justified in view of savings of cartage and storage costs.

Rectangular bales to be left in the field should preferably be stooked. Losses may then be expected to be similar to those occur-

ring with unstooked round bales. If rectangular bales must be left exposed without stooking for periods of a few weeks or months, they should not be left with the cut face to the top. If the cut face is placed to the side it should face away from the prevailing rain.

If bales are to be given any extra protection, covering the tops appears more important than preventing contact with the ground.

The investigations described involved less rainfall (4-11 in.) than could be expected over similar periods in other parts of Australia (e.g. 10-25 in. in Victoria's Gippsland). In these areas, prolonged exposure in the field would probably be inadvisable.

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The Effect of Nitrogen on Non irrigated Maize Sown in Pasture Slits

Since 1953 experiments with slit or sod seeding of maize for grain production have been carried out (Strang 1958). Results from these experiments indicated the possibility of grain production by this method where adequate moisture and nitrogen are available. In 1957-58 detailed field experiments were designed to determine the importance of application of fertiliser nitrogen for obtaining economic grain production from maize while retaining the pasture.

Materials and Methods

An experiment was located at Brundee on Mr. H. Monaghan's property within the Shoalhaven flood plain. The soil type is described by Walker (in press) as an undifferentiated prairie soil with moderately high organic matter, low salt status, and pH of 6.0 at the surface increasing to 6.5 in the subsoil.

Before planting 6 inch slits were opened in the drill line in the perennial ryegrass pasture by means of a small rotary hoe with all but the centre tynes removed. G.H. 128 hybrid maize seed was sown at 10 lb per acre (approximately 15,000 plants per acre) with 2 cwt of molybdenised superphosphate per acre

using a single row maize planter on November 12, 1957.

At seeding and during the growth of the crop sulphate of ammonia treatments were applied according to the programme set out in Table 1. Plots were of 4 rows (3 ft. 3 in. drills) x 99 ft. arranged in random blocks with six replications.

Two one chain lengths (66 ft.) from the centre rows of each plot were harvested on July 24, and 25, 1958. The following estimations were made; oven dry grain yield (80° C), number of plants per acre, number of ears per plant, grain shelling percentage, weight per 1,000 grains and nitrogen content of grain. Nitrogen content was determined by the Kjeldahl method.

Results

As plant populations did not differ significantly between treatments, comparison of the effects of sulphate of ammonia applications on grain yield components is considered valid. Lang *et al.* (1956). Four components of grain yield were determined, ears per plant, weight of grain per ear, shelling percentage and 1,000 grain weight. For grain yield and its components, significant differences were observed between the control and sulphate of ammonia treatments, see Table 2.

The percentage grain nitrogen levels agree with the range reported by Zuber *et al.* (1954). Grain nitrogen was affected by the time of fertiliser application. The treatment receiving

TABLE 1
Sulphate of ammonia application programme.

Treatment	Cwt. sulphate of ammonia per acre.			
	At planting 12/11/57	At 12 in. 14/2/58	At 2 ft. 6 in. 13/3/58	At tasselling 8/4/58
1.	0	0	0	0
2.	2	0	0	0
3.	2	2	0	0
4.	2	2	1	0
5.	2	2	2	2
6.	0	5	0	0
7.	5	0	0	0

TABLE 2

The effect of sulphate of ammonia on yield components and grain nitrogen.

Treatment	Yield bu. per acre	No. of ears per 100 plants	Grain wt. per ear oz	1,000 grain wt. g	Percent grain nitrogen	Grain nitrogen yield lb per acre
1.	4.9	34	0.51	151	1.23	2.75
2.	20.5	55	1.24	170	1.12	8.14
3.	67.0	92	2.69	235	1.17	23.35
4.	73.6	100	2.81	236	1.29	29.42
5.	85.9	112	3.01	248	1.44	35.80
6.	69.0	99	2.87	260	1.33	25.16
7.	49.6	83	2.34	222	1.24	18.62
Min. sig. diff.						
P = 0.05	21.9	16	0.64	41	0.08	10.76

the latest application of sulphate of ammonia in the fertilising programme had significantly higher grain nitrogen content than the other treatments, whereas the percentage recovery in the grain of the applied fertiliser nitrogen was highest for treatments 3 and 4 (see Table 1).

The effects of water and nitrogen supply on grain yield have been discussed by Kurtz *et al.* (1952) in relation to different intercrops. They state that maize yields intercropped in pastures were 10 to 15 per cent. lower than yields obtained under conventional systems with adequate nitrogen when both depended on rainfall. Where irrigation was used with intercrops of grasses and small seeded legumes there was little yield difference from conventional plantings. The pasture on the experimental site at Brundee consisted of perennial ryegrass, red and white clovers. This pasture was selected because seeding into a ryegrass dominant pasture takes advantage of the apparent summer dormancy of the grass, thus reducing competition for water between the pasture and the maize crop compared with summer growing pastures. The importance of competition for water and nitrogen was illustrated by the failure of similar experiments to the one described, slit seeded into kikuyu

(*Pennisetum clandestinum* Hochst) and paspalum (*Paspalum dilatatum* Poir.) pastures in 1956-57.

It is suggested that the technique would be useful, particularly in suitable irrigation areas, where economic grain production is required from maize without losing a great proportion of winter pasture availability.

Acknowledgments

The assistance of the following people is acknowledged with gratitude. Messrs. H. Monaghan, for the use of the land, B. Barkus, for percentage nitrogen estimation, F. McCleery, for statistical analyses, L. R. Kavanagh, for advice, and P. Bramley, for field assistance.

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Growth Rates of Lucerne (Hunter River) and *Glycine Javanica* in a Tropical Highland Envirovment

The tropical climatic conditions of the Atherton Tableland region of the Cairns hinterland—North Queensland—has been previously described (Kyneur and Tow 1958). The conditions are not favourable for the growth of most temperate climate legumes. Until recent times, lucerne was the only available perennial pasture legume which could survive in a mixed sward.

The summer growing perennial legume, *Glycine javanica*, was first planted on this Station in 1947 and has shown great promise. The effect of the species on the growth and palatability of Guinea grass (*Panicum maximum*) has been described by Kyneur and Tow (1958).

In exploratory work to determine the existence of any soil nutrient deficiencies affecting *Glycine javanica*, a trace element test, as described by Anderson (1952) was laid down in March, 1958. The paddock, in which the trial is located, was being prepared for lucerne and a similar test was laid down in the lucerne when it was planted in June, 1958.

The soil is the typical Red Volcanic clay loam (Teakle 1951) of the Atherton Tableland and the area of the trial had been under continuous Maize for approximately thirty years and had suffered some erosion. Investigations with legumes are of paramount importance in problems of rebuilding soil organic matter.

The data of greatest interest so far concern the production of dry matter by the two legumes.

The difference in the relative growth rates of the two legumes when sown in the same paddock during the same season is shown in Table 1. The available dry matter per acre was determined by making 95 x 5 square link cuts on each area of each legume (0.107 acre).

Stock were excluded from the plots during the period May, 1958 to February, 1959. Between February and July 1959, all plots of

TABLE 1

Quantity of available dry matter per acre from
Glycine javanica and lucerne.

Date	Dry matter in lb/acre	
	<i>Glycine Javanica</i> *	Lucerne†
May, 1958	88	0
Feb., 1959	758	469
July, 1959	516	258

*Sown at 4 lb/acre in March, 1956.

†Sown at 8 lb/acre in June, 1958.

both legumes were grazed twice by a herd of dry dairy stock.

The poor production of lucerne, as measured in February, may be attributed to the strong competition from weeds, of which, at the time, there were 2,567 lb of dry matter per acre. By comparison, the amount of weed growth in the Glycine plots in February was 2,389 lb of dry matter. This figure is high but the Glycine still produced very vigorous growth under conditions which appeared to be less favourable for lucerne.

The response of the legumes to the various micro and macro element mixtures will be reported elsewhere.

Acknowledgements

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Storey and W. Hazard in harvesting and drying the samples.

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Changes in the Soluble Sugar Contents of Short Rotation Ryegrass During Growth

The relationship between the soluble sugars and the stage of growth of ryegrass has been examined by a number of workers, including (Norman 1936, 1937), (Sullivan and Sprague 1943, 1949), (Waite and Boyd 1953), (Waite 1957), Mackenzie and Wylam (1957), Schlubach (1957), and Bathurst and Mitchell (1958). The general trend found in these studies is that the total sugars rise to a peak either just before or at the time of head emergence. At this stage fructosans are the main sugars.

All these studies were made in overseas countries. To provide comparable figures for local environments, the effect of maturity in two successive years on the soluble sugar contents over a short period of six to seven weeks up to full flower head emergence has been determined. Amongst other things, such information is helpful in choosing the maturity at which to ensile grass, the quality of the silage depending on the content of fermentable sugars in the fresh material.

Experimental

Material. The material used was short rotation (H1) ryegrass broadcast on a 1/10 acre plot in May, 1955 at Hightett, Victoria. Market garden fertiliser (N, 3.5 per cent.; P, 7.2 per cent.; K, 2.2 per cent.) (1 cwt/acre) and ammonium sulphate (1 cwt/acre) were applied before sowing. The plot was mown and top-dressed with ammonium sulphate (1 cwt/acre)

TABLE 1
Details of samples.

Sample No.	Date Cut	Ht. to uppermost ligule (in.)	Moisture (% dry matter)
1	17.10.55	4-7	-
	15.10.56	-	663
2	24.10.55	8-9	481
	23.10.56	-	510
3	31.10.55	10-16	383
	30.10.56	-	440
4	7.11.55 ^a	16-22	402
	5.11.56 ^a	-	361
5	14.11.55 ^b	18-22	305
	12.11.56	-	333
6	21.11.55 ^d	23-25	306
	19.11.56 ^c		289
7	26.11.56 ^d		277

a. Flower heads beginning to form.

b. Heads emerged on about 1/10th of tillers.

c. Heads emerged on about 1/3rd of tillers.

d. All heads emerged.

in September, 1955, February, 1956 and August, 1956.

An area of fairly even growth was marked into plots 2 ft. square. Three plots were taken at random at each harvest. The material was cut between 9 and 10 a.m., chopped up, mixed by hand, and a representative sample dried at 70° C in a cabinet with forced draught. The dried material was stored in screw-topped jars in a deep freeze unit (-18° C) until analysed. Further details of the samples are shown in Table 1.

Analytical Methods. The dried samples were ground in a Christy and Norris mill using a ½ mm screen. Moisture contents were determined by drying at 105° C for 16 hours.

Hexoses and sucroses were determined by extracting with ethanol (Wylam 1954) and sugar estimations made as recommended by the Association of Official Agricultural Chemists (Anon. 1955) except that Amberlite 1R-4B anion exchange resin was used for deionization instead of Duolite A-4. The sugars were determined before and after hydrolysis giving the percentages of hexoses and (hexoses + sucrose) respectively. Sucrose contents were

TABLE 2

Sunlight and rainfall.

Harvest No. *	Sunlight (Hrs)				Rainfall (points)			
	1 Day before cutting		Total for 7 Days before cutting		1 Day before cutting		Total for 7 Days before cutting	
	1955	1956	1955	1956	1955	1956	1955	1956
1	6.8	5.9	-	-	nil	nil	-	-
2	8.0	11.5	57.3	32.9	nil	5	74	149
3	9.3	3.4	56.9	34.4	nil	29	21	124
4	6.3	6.2	45.5	34.3	nil	2	98	102
5	8.0	1.2	42.8	45.9	nil	nil	38	87
6	11.0	5.7	49.6	31.9	nil	18	5	116
7	-	5.0	-	47.7	-	nil	-	nil

* See Table 1.

estimated from the difference. Some fructosan may be included with the sucrose.

Fructosans were determined on the ethanol extract by the method of Arni and Percival (1951).

Weather Records. The weather records were obtained from the Division of Meteorological Physics at Aspendale (8 miles distant). The total amounts of sunlight and rainfall on the day before cutting the samples and also on the seven previous days are shown in Table 2. More hours of sunlight and less rain were recorded over the harvest period in 1955 than in 1956, probably accounting for the faster rate of maturing in the former year.

Results

The variations in the soluble sugar contents with time of cutting (Figures 1 and 2) followed the same pattern in both 1955 and 1956. Hexose contents did not show any definite trend with stage of growth. On the other hand the sucrose contents were at a maximum just before the flower heads began to form in 1955 (October 31) and when the

heads were beginning to form in 1956 (November 5), then tending to decrease as the plants matured further.

The fructosan contents also increased with the growth of the plant, being at a peak when the heads were beginning to form in 1955 (November 7), and when the heads had emerged on about one third of the tillers in 1956 (November 19). At this stage fructosans were the main sugars. With further development the fructosan contents tended to decrease.

Total sugar contents varied in a similar way to the fructosan. Calculated as a percentage of the freshly cut material they were at a maximum one week before the heads had emerged on all the tillers.

Discussion

The trend of the total soluble sugars (Figure 2) agreed reasonably well with the results obtained by Waite and Boyd (1953) and Waite (1957) for biennial and perennial strains, the contents being at a maximum about the time of "head emergence".

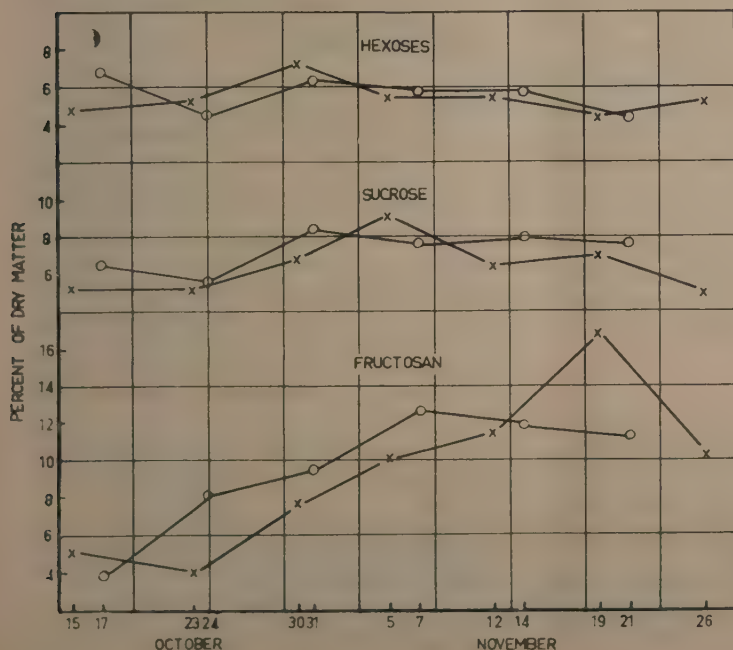


Figure 1—Ethanol (90 per cent.) and cold water soluble sugars. O, 1955; X, 1956.

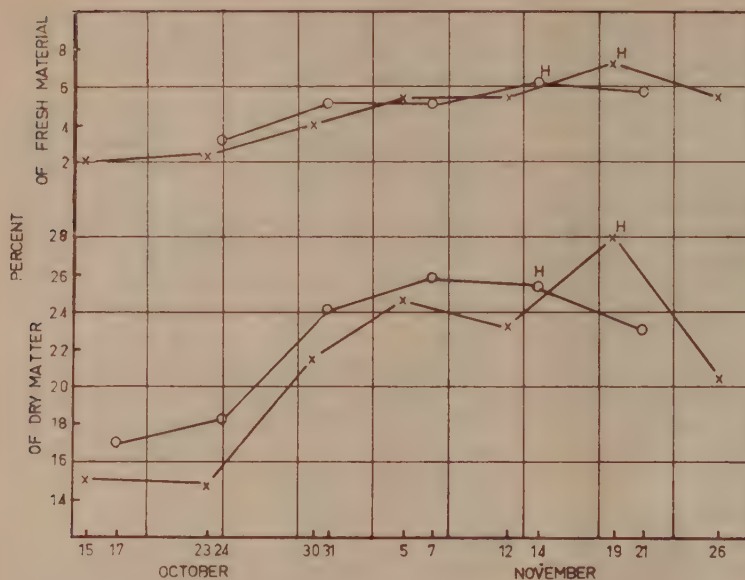


Figure 2—Total soluble sugars. H, Head emergence; O, 1955; X, 1956

There was no relationship analogous to that observed by Mackenzie and Wylam (1957) between the soluble sugar contents and the hours of sunlight received by the plants; the variations in this factor in the present experiment may not have been sufficient to affect the rate of photosynthesis.

Percival (1952) has suggested that the fructosan content of herbage may be the important factor for making good silage. Fructosan is easily hydrolysed and under favourable conditions may contribute largely to the production of adequate lactic acid. On this hypothesis, or simply from a consideration of total sugar content, the foregoing results indicate the stage of growth best calculated to give good results when ensiling ryegrass.

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Book Review

Relations Between Water and Soil

By T. J. Marshall

Commonwealth Bureau of Soils, Technical Communication No. 50 (pp. 91). Obtainable from the C.A.B. Liaison Officer at 314 Albert Street, East Melbourne, C.2, Victoria. Price 25/-.

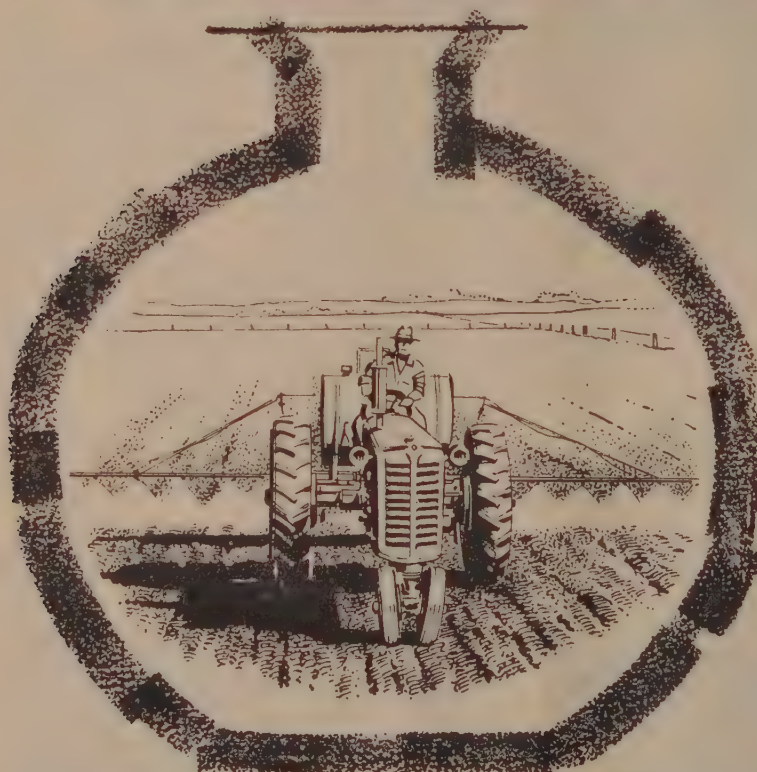
This fiftieth of the Technical Communications of the Commonwealth Bureau of Soils is one of its most ambitious. It is not a compilation, like many of its predecessors, but a textbook written by an active worker and leader in the subject. It is brought right up to date at the time of publication, and this includes the recent agreements on terminology. There are 74 pages of letterpress and about 350 references, nearly all of which are in the English language. The interest is dominantly for the agriculturist rather than the engineer, and the scope is a very large part of classical soil physics—soil as a store for water, movement of water as liquid and as vapour, availability for plants, measurement of water *in situ*.

The Communication is simply and clearly written, and does not assume a greater background of general scientific knowledge than is possessed by the average agricultural scientist. While mathematical formulae are quoted here and there, mathematical discussion is kept to a very modest level. Not only are the controversial topics like pF and availability thoroughly reviewed, but many facts and relations are here assembled for the first time.

The book should have a place on the shelves of the agricultural scientist alongside any of the established textbooks.

W. IVES.

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Thesis Summary

Studies in the Germination, Early Growth, Drought Survival and Field Establishment of Buffel Grass (*Cenchrus ciliaris*) and of Birdwood Grass (*C. setigerus* Vahl) with particular reference to the Yalleroi District

Germination of four strains of buffel grass improved from 2 per cent. at harvest to 38 per cent. after eight months of dry storage at room temperature. W.A. strain showed substantially greater dormancy than these strains.

Seed fascicles responded to dry storage at 40°C for four weeks. Results of tests with moist chilling, air pressure and removal of hulls are discussed.

Concentrated sulphuric acid increased the rate and percentage of germination, 24N for 30 minutes giving the highest increase. When trays of soil were incubated, emergence of acid treated or hammer milled seeds was less sensitive than untreated fascicles to variations in soil moisture content. In the field, acid treatment and hammer milling greatly reduced establishment after dry sowing. This effect was attributed to almost complete germination of the treated fascicles following light showers.

In a pot experiment with a loamy sand, percentage emergence of buffel and Birdwood grasses was not very sensitive to sowing depth down to two inches, but rate of emergence was related to depth.

Some growth characteristics of the four commercial buffel grass strains and common Birdwood grass were examined when grown in the glasshouse on the reddish brown sandy soil of the cabbage gum and bloodwood community of Yalleroi, under conditions of varying nitrogen, phosphorus and moisture supply.

The form in which shoot growth was manifested varied greatly according to genotype, and was less affected by variations in nutrition. The early growth of shoots showed large responses to phosphorus, and to nitrogen in the presence of phosphorus. Both leaf surface and net assimilation rate were increased. Effects on leaf and tiller size and number are discussed.

Root growth was greatest in the late maturing strains, Gayndah and Biloela. Applied phosphorus increased root growth and the ratio of shoots to roots. Low watering depressed this ratio.

Moisture use was independent of strain, but was increased by fertiliser application. The ratio of yields to evapotranspiration was also enhanced by fertilizers.

In view of responses in field survival to applications of a complete NPK mixture, buffel and Birdwood grasses were sown in pots with phosphorus and/or nitrogen dressings, watered, allowed to dry out, and survival noted upon re-watering.

Gayndah and Biloela strains showed superior seedling drought survival. This was probably associated with lateness of wilting and root development.

Applied phosphorus reduced survival in an experiment with 2 kg pots, where all pots were re-watered on the same day. When the drought period after final wilting was equalised, phosphorus increased survival. In 6.5 kg pots,

wilting date was independent of phosphorus and survival enhanced by it.

In field trials, establishment was improved by seed coverage. Establishment was roughly proportional to the degree of cultivation, and was quite unsatisfactory on uncultivated

ground, irrespective of burning treatment. Cultivation and seeding immediately after burning were desirable.

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Some Factors Affecting the Nitrogen Economy of a Humid Subtropical Soil and a Semi-arid Temperate Soil

Studies are reported on some of the pathways of nitrogen metabolism important in the nitrogen economy of two soils under different systems of agricultural utilization. The influence of specific environmental factors on the processes of mineralization (ammonification and nitrification), and denitrification has been examined in detail in both laboratory and field experiments. An attempt has been made to evaluate the nature of the nitrogen economy for the usual farming practice on each soil by consideration of the major processes concerned in gain and loss of nitrogen. One of the soil groups, the krasnozem, was a subtropical humid soil from the dairying district of Lismore in northern New South Wales, Australia. The other soil, a temperate semi-arid member of the chestnut group, has been used extensively for wheat growing under dry farming conditions in the Umatilla County of eastern Oregon, U.S.A.

The studies on the krasnozem soils sought to establish whether changes in the nitrogen status and metabolism of these soils were responsible for the reported decline in productivity of grassland pastures. In addition, the extent to which the introduction of legumes by sod-seeding into established grassland pasture would affect the processes of nitrogen transformation and nitrogen economy was investigated.

Comparisons of soils of known utilization history with virgin soils established that a decline in total nitrogen to approximately 80

per cent. of the virgin level had occurred in many of the utilized soils. A slightly greater decline in the capacity of the soil nitrogen to mineralize was observed. Incubation studies in the laboratory showed that at optimum moisture content and temperature, the ammonification and nitrification processes were as active as in other mineral soil groups in the region. The effect on these processes of air-drying, mineral nutriment additions, and amelioration was also examined in the laboratory experiments.

The field experiment at Lismore was of two years' duration, during which time, nitrate-nitrogen, ammonium-nitrogen, moisture content, and mineralization values were determined at approximately monthly intervals in grassland sward, and in grassland sward which had been sod-seeded with legumes. Monthly herbage yields were also recorded in order to estimate the effect of nitrogen balance of fixation by the introduced legumes.

The results of the laboratory and field experiments showed that although environmental conditions were generally favourable under the sward, nitrification was of little consequence. Ammonification was active, however, and ammonium-nitrogen was invariably present in both the surface and subsoil. This appeared to be the major source of nitrogen for the growth requirements of the grasses. In the improved treatment, increased mineralization values of soil nitrogen occurred after senescence of the clover. This increase was temporary. In the

short term, there was no evidence of increase in nitrogen yield in the grasses associated with the legumes, nor of any marked increase in the total nitrogen of the soil, whether determined directly by experiment or calculated from herbage yield data. The high levels of nitrate-nitrogen and ammonium-nitrogen found in surface samples of cultivated soils indicated high metabolic activity where plant cover had been removed and the soil exposed to the extremes of temperature.

Laboratory denitrification studies using a specially designed electrolytic respirometer and isotopic nitrogen provided evidence that denitrification was unlikely to be of consequence in krasnozem soils under the usual conditions of moisture and aeration in both sward and cultivated soils. Although some decline in total soil nitrogen was evident, the availability of nitrogen in the krasnozem soils was high compared with other soils. Lack of nitrogen uptake in *paspalum* pastures in the Lismore district, and the belief that a decline in productivity has occurred may be related to factors other than availability of soil nitrogen.

The studies on the chestnut soil were confined to the processes of ammonification, nitrification, and denitrification. Some of the factors affecting these processes were studied in the laboratory by incubation techniques. Denitrification studies were made by an incubation method using isotopic nitrogen, and also with the electrolytic respirometer. The results of these studies indicated that losses of nitrogen by denitrification were probably slight under the conditions normally encountered in the field. A field experiment failed to show evidence of any marked nitrogen transformation during the summer. It was suggested that the prevailing practice of maintaining a trashy fallow between wheat crops, with subsequent additions of nitrogenous fertilizer to overcome the straw factor, was probably arresting soil nitrogen losses and perhaps even contributing to a rise in level of total nitrogen.

J. W. McGARITY.

Awarded the degree Ph.D. by the University of Sydney, 1959.

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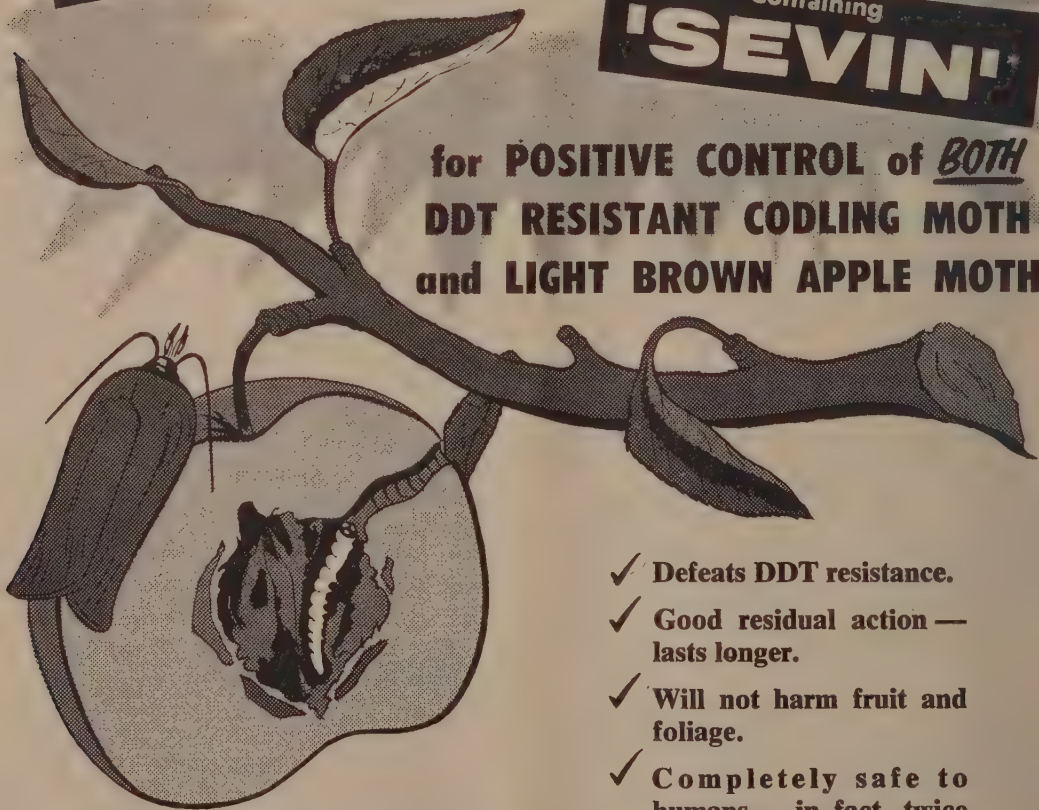
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University Enrolments

Dear Sir,

Institute members may be interested to learn of the changes in actual enrolments at universities in 1958 and 1959, compared with the estimates for those years incorporated in the Murray report in 1957.

These changes influence significantly the basis of our estimates of university enrolments in the Faculties of Agriculture presented on page 12 of the Institute's report "Agricultural Scientists in Australia".

Actual total enrolments in 1958 were 41,770 compared with the estimate of 40,880. Preliminary estimates for 1959 (as at the end of 1st term 1959) show enrolments to be 46,841 compared with the estimate of 44,360.

New enrolments for bachelor's degrees in 1958 were 8,936 compared with the expected 7,737. In 1959 new enrolments for bachelor's degrees were 10,188 compared with the estimate of 8,463. That is to say, the actual number of new students enrolling for bachelor's degrees exceeds the estimates by more than 20 per cent.

In the agricultural science faculties, enrolments of new students in 1958 rose to 270 (our estimate was 263). In 1959 enrolments were 284 compared with our estimate of 217-283. New male agricultural science students were 3.66 per cent. of all new male students in 1958, but the proportion was to 3.45 in 1959.

These figures exclude students in Wool Technology at the University of N.S.W. and students in the Faculty of Agricultural Economics at the University of New England.

The Commonwealth Statistician has provided the following data on enrolments in 1958 and 1959. The 1959 data are still preliminary being based on information provided at the end of first term, 1959.

Enrolments of Agricultural Science Students

University	Total Enrolments		New Enrolments	
	1958	1959	1958	1959
Sydney	229	204	69	43
New England (Excl. Ag. Econ.)	71	98	39	49
Melbourne	230	212	61	56
Queensland	127	176	50	74
Adelaide	85	87	25	26
Western Australia	60	75	21	28
Tasmania	7	10	5	8
Total	809	862	270	284

New students in the official statistics include new enrolments in the Faculties whether they be in first year, or subsequent years. They do not correspond with first year enrolments which include students repeating the year.

It is evident that our estimates of the flow of graduates in the future may be on the conservative side; although if the rate of enrolments compared with other faculties continues at the low 1959 level our estimates will be confirmed. That is to say, so far as agricultural science students are concerned, the increase in total numbers of students enrolling at universities has been offset by a decline in the percentage undertaking agricultural science courses. These two factors will both need to be taken into account in making adjustments to the estimates of the flow of graduates in our report. As a matter of interest, in 1959, the new students undertaking agricultural science courses rose by 5.2 per cent. compared with a rise in total enrolments for all bachelors' degrees of 14 per cent.

Yours, etc.,

W. IVES,
D. B. WILLIAMS.

The Third Force in Farming Progress

Dear Sir,

On the first afternoon of the recent Victorian Refresher School on Animal Production one speaker suggested that, in general, discussion should be confined to fundamental scientific issues, to the exclusion of farming implications of each topic, except during those sessions in which papers on farm management were to be presented.

During the afternoon I noticed that discussion had to be coaxed along with some difficulty after the presentation of the papers, and was sporadic until someone raised an issue with some direct farming implication. This brought forth a quickening of interest and a lively exchange of views which ended only when time ran out.

This was not surprising; for, after all, farming is our only common meeting ground. It is the only substantial link between the cereal breeder, the irrigation horticulturist, the poultry research worker and the dairy technologist, although all would claim that they belong to the profession of agricultural science.

More important still, farming is our main link with our ultimate consumers, the farmers. They may not employ us directly, but it is they who determine how much our services will be in demand. There is every reason, then, why we should get together and translate each one of our findings into practical farming terms. No furniture maker would sell a three-legged chair with the remark, "It is standing there in the corner all right, but maybe you

had better find something to use as a fourth leg." Yet that is what we sometimes do with our research findings.

It is not essential that every fundamental researcher should carry his work through to farm scale trials, but at least he should be in touch with other members of the profession who investigate his findings as applied on farms.

In the past, such members have been few in number, and those who existed were often regarded as people who merely repeat the findings of research, with a few tricks of propaganda to make them sound more attractive.

The extension worker of today, and even the agricultural scientist turned salesman, cannot afford to be a mere repeater station. He is just as much an investigator as is the fundamental researcher, but his researches are a stage nearer to practical farming. He and his kind are the third force, acting between the fundamental worker and the farmer, who ensure that every chair we sell is complete with its fourth leg.

Let us think beyond the parish boundaries of our profession and pursue our discussions through to their farming conclusions. It will make us better investigators at every stage, and it will lead to better markets for our jointly manufactured end-products.

Yours etc.,

K. M. SILLCOCK.

Department of Agriculture,
Victoria.

Agricultural Consultants

The following three talks were given to the Symposium, Agricultural Consultants, organized by the New South Wales Branch of A.I.A.S. and held in Sydney on July 31, 1959.

The Bombala District Rural Advisory Service

H. E. B. Shaw, President, Bombala District Rural Advisory Service.

The formation of a Private Advisory Service for Graziers at Bombala was not accidental, but the outcome of serious and lengthy discussions amongst a group of keen and progressive men.

The area was at the extreme end of a large district allotted to one Agronomist with headquarters at Queanbeyan. After 2 years in the district he had some 2,300 graziers asking for visits. It will be readily appreciated that the distances involved, the difficult mountain roads and such numbers made this an almost impossible task, the value of quick inspections and on the spot advice being completely lost. In addition the wide variety of land and farm types and rapid changes from one to another led to specialised problems, the answers to which could not be found in experiments in other areas.

A pasture and animal production school held in 1954 really sparked district interest. This school was organised by Mr. Douglas, then District Agronomist, and myself representing the Bombala Branch of the Graziers' Association. It was eventually decided that the best move for local graziers would be to form a compact group and employ an agronomist.

The Bombala group is now in its fourth year, the past three having been very successful. Of the 34 original members, two have resigned, but the club has grown to 42. There is some interest in the employment of an additional consultant, a veterinarian.

One of the most successful overseas agricultural consultant organisations is the Doane Agricultural Service which now operates in 17 states of the U.S.A. and employs 100 consultants. In New Zealand, clubs are flourishing.

There is an ever-increasing demand from producers to have the latest and best advice available to them as quickly as possible. This advice must cover the whole gamut of production including general planning for the future. The economic side must not be forgotten.

It is the duty of a consultant to have agronomic, economic and animal husbandry knowledge and to help the member do the right thing. No consultant should try to force a member into decisions alien to him, but try to keep a balance.

To set up a group or service, the following points are of paramount importance—

You must have a group of people keen to advance. The area to be covered by the adviser must be limited to a reasonable size. You need a constitution which comes as near as possible to fulfilling requirements. You must be able to employ a keen and competent consultant on a satisfactory salary. The adviser must not be restricted to his area, but allowed to attend schools and conferences elsewhere. The group should subscribe to farm journals and reference books.

By being independent, the Bombala group has developed a sense of fellowship which has made for easier discussion of common problems and quicker dissemination of knowledge.

Some problems which need close attention are—The area and membership must be strictly limited. Travelling must be limited to reduce cost and loss of time. Group buying and concessions which can be of great economic benefit must be controlled or they become overwhelming. We limit our purchases to seed and veterinary requirements. Office space, periodicals, reference library and competent office staff are important.

The Bombala service has received the fullest co-operation from the Department of Agriculture, C.S.I.R.O., Universities of N.S.W. and Sydney, B.A.E. and commercial firms.

Bombala District Rural Advisory Service Resume of Constitution and Rules

A. Objects are—

1. To promote the development of primary production in the area by planned property development and to employ an expert agriculturalist for this purpose. When not detrimental to the members, the services would be available for non-members.
2. To collect fees from members, and to pay the salary and expenses of employees.

3. To purchase seed, fertilisers and other requirements for members.
 4. To promote lectures, field days, etc. for members.
 5. To establish a nursery (if required) for members.
 6. To purchase, lease, rent or exchange property as may be considered advisable, to borrow money for the Service and secure payment thereof, and for that purpose to charge or mortgage all or any property of the Service, etc.
 7. To co-operate with any research institution in investigational work for the benefit of the Service.
 8. To co-operate with or join other bodies with similar aims.
- B. To use all income for the benefit of the Service.
- C. To limit membership to between 30 and 50 bona fide graziers.
- D. Retirement of a member allowable on 2 months' notice. Members can be expelled by the vote of a majority.
- E. Annual subscriptions are based on the acreage:—
- | | |
|-------------------|-------------|
| 0 - 1,000 ac. | — £ 30 p.a. |
| 1,000 - 1,500 ac. | — £ 45 p.a. |
| 1,500 - 2,000 ac. | — £ 60 p.a. |
| 2,000 - 2,500 ac. | — £ 75 p.a. |
| 2,500 - 3,000 ac. | — £ 90 p.a. |
| 3,000 - 3,500 ac. | — £105 p.a. |
- Progressively up to 9,500 - 10,500 ac. — £165 p.a.
- These fees are minimum and may be subject to a levy of 10 per cent.
- F. Management to consist of seven members of an executive committee; the adviser shall act as secretary and treasurer at all meetings but has no vote.
- G. The Executive has the power to effect the objects of the Service.

The Consultant as a Medium of Extension

*Mr. R. A. Pearse, Lecturer in Farm Management,
University of New England.*

There are a considerable number of varying ideas on what extension means. Some regard it as essentially a two-way process in which the findings of research workers are conveyed to the farmer and problems and observations of the farmer are transmitted back to the research worker. Others visualise

a more complex flow depending on a specialist condensing the results of pure and applied research to a coherent whole which the extension worker could then pass on to the producer.

How do people accept new information and put it into practice? American workers suggest five stages in the adoption of a new technique by an individual. They are; awareness, interest, evaluation, trial, adoption. For awareness and interest, mass media such as press and radio are effective, but for the evaluation stage a personal relationship is more important. The farmer must discuss the subject with a neighbour, salesman or extension officer. At the time of decision personal contact is of dominating importance.

These workers went further and found that there were four categories of change or innovation:—

- A. A change in materials or equipment, i.e. using more fertiliser or a more powerful tractor.
- B. Improved practice or change in technique, i.e. from no fertiliser to some fertiliser.
- C. Innovation.
- D. Change of enterprise, i.e. from wethers in New England to fat lamb production.

They found that each succeeding category required a greater amount of re-organisation of existing routine and more skill in integrating into the present farm pattern and hence greater difficulty of acceptance.

It is thus necessary to do more than merely inform the farmer of a new technique; he should be helped to solve his problems and integrate the practice into his farm programme. This needs a whole farm approach. It can be said that extension should embrace not only the flow of information but also its successful adoption.

Dr. Schapper of the University of Western Australia has pointed out that it is important to know the type of farmer being dealt with and the response that can be expected from a specific extension method.

Advisory material reaches farmers through Government agencies, private commercial organisations, private extension organisations, i.e. farm management clubs, and individual consultants. An adviser or consultant should be in a position to present all possible alternatives, and the likely outcome of their adoption. Often he is not in a position to do this, as it is extremely difficult to determine the most economic practice on an individual farm. Even if he was he must be careful not to make all the decisions or a farmer will tend to become a labourer on his own property. Advice is often based on technical efficiency or on a part-farm approach which need not be the most profitable level or line of investment.

A consultant employed by a firm depending on the supply of rural raw material, e.g. milk vendors or by a firm of accountants, would have some access to the farmer's records and is therefore in a stronger position to give worthwhile advice, provided he has time to do so.

The consultant employed by a group of farmers, say 30 to 80, can give intensive advice and, after he has gained their confidence, should have access to farm records. Such a consultant owes allegiance wholly to his employers and should be fully capable of giving disinterested and unpalatable advice.

Finally we must consider the private consultant who is available for consultation at a suitable fee. As his livelihood depends on good advice he will need to give it. The danger here is that he may only be called in when the trouble is very apparent and may have become quite complex. To overcome this problem he may build up a clientele on an annual basis.

In conclusion, it may be said that personal contact is essential for effective extension but at present it is very thinly spread. Thus any increase in the number of consultants would help the situation. Commercial consultants are very thinly spread and suffer from the disadvantage of a prime duty towards their employer.

In view of this it would seem that the effectiveness of consultants for extension may well be in farm management clubs and in connection with accountants than in any other non-government form. If the private consultant spreads himself too thinly and is unable to gain the confidence of the farmer and work fully with him, I feel that he may be no more effective than if he were in government service.

The Role of the Private Agricultural Consultant

Mr. W. A. Beattie, Agricultural Consultant, Melbourne.

The present free and socialised extension services are not flexible enough to meet modern change. They will never command sufficient budgetary support to ensure their being adequate and, furthermore, they only meet a comparatively small part of the demand for the services of trained people. The balance of the demand has to be met by untrained people, a state of affairs which we should not allow to continue, in the interest both of the public and ourselves.

However, there should be no diversion of funds which would result in reduction of our research services, nor should research be limited to questions of immediate economic need.

One of our greatest difficulties nowadays is to keep pace with the output of research and to interpret it in the light of particular problems. This is beyond the state as it would mean the freeing of staff from all administrative and allied activities. This would run against the present trend for more administration by specialists in these institutions. There is no basis for hope that this trend will be reversed.

The type of service the farmer wants is roughly as follows. Firstly, he wants a discussion on some specific worry. He doesn't want or expect you to make a decision for him. His is the farm, therefore his is the decision. In the discussion he will expect you to refer to every factor. You will probably have to learn, from him, much of local conditions and practice, which could have much to contribute. He must have confidence in you and your judgment. He won't mind at all if you have to take time to think further or check on certain scientific information, provided that in the end you provide him with a sound, sensible and workable basis for his decision.

As a former farmer, I must say that I rather deplore the trend towards psychological investigation of the motives and ways of thought of farmers, because, although they may be appropriate to a peasant community, I think they have very little to do with our completely normal independent Australian producers whose ways and motives are no different from the rest of the community. I also rather deplore the investigations into their finances and private lives because it is a serious encroachment on the normal democratic right to be themselves and live as they want to. Any confidential matters should be treated as such and as a private practitioner I have no more right to ask personal questions of producers than they have of me.

The relationship between consultant and farmer is, in addition, a continuing one. To that extent it is similar to that of a family doctor or lawyer and so is much more intimate and personal, than anything which the state could provide. I can see no possible substitute for it if farmers are to have adequate assistance. It is a true profession, interesting and rewarding to those who take it up and adding to the stature of the Agricultural Faculty as a whole.

We should remember that we alone have failed to produce a privately practising profession. Engineers, architects, doctors, lawyers all regard the private

general practitioner as the core of their whole existence and I think the time is now ripe for us to follow suit. Once the institution of private practice is developed I think there will be a tendency to division, as in the medical profession, with the general practitioner on the one hand and the specialist on the other. This is more logical than the present situation with many specialists and co-ordinators. The farmer is in a sound position to pay for the service which, as it grows, should be no more expensive than the services of any other professional man.

Local advice is often given by institutions such as banks and stock and station agencies, often by individuals with no basic scientific training, and only as a sideline to their main activities. All this piecemeal stuff is likely to do more harm than good. Is our work so simple that we can teach such people how to advise farmers? I don't believe that the "something is better than nothing" argument is of any validity in the modern farming world. We have not tried to assume our responsibilities in these matters.

We should take over the field of personnel management as it affects primary industry. We should do all the rural advising for Trustee Companies and Banks.

The offices of private practitioners would give training for graduates in the hurly-burly of private practice. This would broaden their experience and make them more acceptable both to farmers and those institutions which should employ them technically. This would overcome the mutual distrust or misunderstanding which occasionally exists between the farmer and the adviser who finds it hard to relate his technical training to everyday farm practice.

Discussion

A vigorous general discussion followed the delivery of the three papers. The main points raised were:—*Nature of training required for agricultural consultants*— General agreement on the need for a degree in agricultural science, together with pre- or post-graduate training in farm management. A post-graduate course is already in existence at the University of Sydney and one will commence at the University of New England in 1961. It was agreed that post-graduate extension experience was essential.

A place for the Institute— The danger of unqualified consultants was mentioned. The Institute could take the initiative by encouraging farmers to form clubs or use consultants as they become available. *Comparison between clubs and private consultants*— It was pointed out that veterinary clubs had not proved permanent and had given way to private

practitioners. This could be an evolutionary process. The presence of a small number of consultants should increase the demand for more—at present many farmers do not seek advice as they know of no one who could help them.

The consultant in a club— After a few years the club members may tire of their consultant or vice versa. It would be to consultants' advantage to band together for greater support, allow for transfers between clubs and to foster the idea in new areas. Salary, promotion and security were raised. In Bombala, superannuation is covered by an assurance policy. The really efficient agriculturalist should command a high salary, and he would be more likely to get this and security in research work.

Relationship between consultant and client— Some thought the consultant should have access to the farmer's books. Others thought it was impossible for a consultant to consider all possibilities and should not depend on access to the books, although he could use them if the farmer so desired. This latter was the case in Bombala. Mr. I. Johnstone (consultant—Armidale) said that all the consultant need know is how much the client is willing or able to spend in the coming year or years. Some felt the consultant should leave the farmer with alternatives and let him make the final decision; others thought that the farmer should be left with such sound advice that there was no alternative. Johnstone said that he previously charged clients on an annual basis but this left the onus with him. He now charges on a job basis with the onus on the client to contact him when required.

Types of clients— Johnstone mentioned the types of clients he has had. They are business men easing tax burdens with farm development, a group of properties suffering from low lambings, a group interested in irrigation, some properties are on an annual call basis. He stressed the desirability of a fixed clientele such as a pastoral firm. He conducts a worm egg-count service and soil tests in a glass house.

Problems confronting a private consultant— One problem is building up a clientele at the start. Another is secretarial as the consultant is normally absent from home during the day. There is a need for an economic advisory service to consultants—it was mentioned that Schapper is setting up such a service in W.A. A consultant must consider his overhead costs such as office space and equipment, vehicle and travelling allowance, telephone, publications and secretarial costs.

Return of information to research workers— This could break down with private consultants, or it could be stepped up due to closer contact with the real field problems.

Superphosphate in New Zealand

Mr. D. Berry in Presidential Address to the Tasmanian Branch, April, 1959.

Development of agriculture in New Zealand has been to a pattern, similar to that in Australia, though it has been faster. The rapid development has gone hand in hand with a similar development in the use of fertiliser.

In the early stages of white settlement, the need for food resulted in the development of farming in the areas surrounding settlements. In their turn, the more remote and extensive areas were occupied and the production of wool rose to importance.

In the 1880's, refrigeration enabled the export of dairy products and meat, and topdressing of pastures was begun about this time. The increase in production and living standards encouraged Governmental action in closer settlement of large holdings. The sheep industry turned from wool to fat lamb production, particularly on the better-class land.

This set the pattern for the predominantly grass-land farming of modern New Zealand agriculture. Later developments were mainly directed at a greater intensity of production. The most spectacular development is the quite recent use of the aeroplane in agriculture. Topdressing accounts for 90 per cent. of this aerial activity. Aerial topdressing was first tried in 1939. In 1950 5,000 tons were dropped. In 1958, 464,000 tons were dropped from over 200 aircraft.

The diversity of the methods used, to apply fertiliser, place New Zealand in a unique position, and certainly contributes to New Zealand having the world's highest production per head of rural population. As in Australia, the chief deficiency has been phosphorous.

Before 1881, various organic fertilisers were either produced locally or imported. Rock phosphate and, probably, superphosphate were imported also. In 1882, the first superphosphate production, in New Zealand, was begun near Dunedin.

By 1900 New Zealand used 40,000 tons of fertiliser. Development of the rock phosphate industry in the Pacific Islands, put the superphosphate supply on the continuing and economic basis and despite setbacks due to two wars and a depression, fertiliser consumption rose to over 1 million tons in 1955-56. Topdressing of pastures takes about 90 per cent. of the fertiliser used. The fall in prices of farm products has caused a fall of 10 per cent. in each of

the last two years, but there is a widespread feeling that the recession is only temporary.

Bulk fertiliser amounts to more than 50 per cent. of the total fertiliser used, over 400,000 tons being applied by aircraft and over 100,000 tons by land spreading.

Factors contributing to the successful development of bulk handling were: the farmer's and the industries desire to reduce costs; the desire of all parties to eliminate delays in periods of high demand; the accumulation of knowledge and experience from bulk handling of lime; the development of a free running, non-setting, non-acid fertiliser by the addition of serpentine; the widespread acceptance by the farmer of the contract system in the carting and spreading of fertiliser.

The stockpiling of lime by spreading contractors led to the first essays in using bulk fertiliser. Bags were dearer than the lime they contained and so unsheltered bulk storage was begun. However, fertiliser will not withstand weather as lime does and so the bulk store began, leading in turn to the development of more efficient equipment.

During the war, superphosphate was diluted with crushed serpentine apparently as a means of rationing. This mixture gave a fertiliser of such excellent physical condition and handling qualities that its manufacture was continued and today a mixture of 3 parts of superphosphate to 1 part of serpentine is made. A recent development is "Aerial Superphosphate" which is superphosphate having 10 per cent. of serpentine in the final mixture.

In addition to lowering the phosphate content of the fertiliser the serpentine acts as a reverting agent and lowers the water-soluble phosphate content, but general opinion is that there is no significant difference in the growth responses of pasture. It is noteworthy that there is no difference in the price of superphosphate, serpentine superphosphate or aerial superphosphate.

Granulated fertiliser is not manufactured to any great extent. The demand for it is small because of higher cost and instability of the granules.

Bulk Fertiliser Distribution

Handling at Works Various methods of loading and accounting are used. In general, the fertiliser is measured by weigh-bridge, but in some cases, one and two ton preweighing hoppers are used. The more modern conveyor belts give loading rates of up to 60 tons per hour.

Cartage is by road or rail to bulk stores or to properties. While a few farmers cart for themselves, fertiliser is mostly carried by contractors who may or may not engage in bulk store operation and contract spreading. New fertiliser works have made some bulk stores redundant, but the stores are used as buffers against periods of high demand. Usually, cartage is by a four ton truck equipped to act as a spreader, towing a six ton trailer, the rear end of which may be raised hydraulically to approximately 8 ft. The floor of the trailer is actually a conveyor belt powered by a small petrol engine which also supplies power for the hydraulic hoist.

Cartage by rail is usually to a bulk store and the fertiliser is transferred either to the shed or direct to a contractor's lorry. The clam-shell type of grab mounted on a tractor is a most flexible unit for unloading and loading.

Bulk Stores: These vary in size, the largest being 800-1,000 tons capacity. It is necessary to handle 10,000 tons or more annually to make these stores a paying proposition, but handling of lime assists in achieving this. In some cases—where cartage gives the main income—no charge is made for storage. However, the average charge for storage and handling is approximately 10/- per ton. Aircraft operators often maintain bulk stores of their own, but these are not large and are mostly for storage of reserve supplies for their aircraft operations.

There are 65 stores in the North Island and their total capacity is 28,000 tons. There are only two stores in the South Island.

Farm Storage — The crudest and cheapest farm storage is on the ground. Tarpaulins are needed for cover and must be replaced constantly. Even so, losses occur. The best storages are sheds having such refinements as removable doors and roofs which lift off or roll back.

Site is important, as it is often possible to place the store so that fertiliser can be dropped into it from above but removed from floor level.

Farm storage is confined to those areas in which aircraft are the top-dressing machines, as fertiliser cannot be carted to a farm as quickly as aircraft can spread it. As aircraft charge by the hour, the better the farm organisation, the lower the cost per ton for spreading. In 1950 the average tonnage per aircraft-hour was 2.34 and in 1958 this had risen to 7.07 tons per aircraft hour.

Usually, the farm store is located at the airstrip which probably serves a number of farmers.

The demand for mixed fertilisers is quite high and is rising. The manufacturers are prepared to mix anything with superphosphate which will encourage farmers to use it, i.e. they appeal to the farmers, using superphosphate as the carrier of another service. This also allows prices for mixed fertilisers to be as low as possible because of their mass production.

Most of the previous information applies only to the North Island where 75 per cent. of New Zealand's fertiliser is used. The North Island has the higher fertiliser usage, the higher rate of usage, the more intense distribution and spreading organization, and the higher agricultural production. In the North Island some contractors' price lists do not quote for rates of less than 3 cwt per acre.

The North Island farmer is proud of his reputation as an intensive farmer, and is prepared to try the unorthodox if it promises more efficient production.

The Work of the Haughley Research Institute

*Lady Eve Balfour, in an address to the South
Australian Branch*

The Haughley Research Institute consists of 200 acres subdivided into three self-contained units, viz., a Stockless section, an Organic section and a Mixed section, each worked under a different system of management.

The stockless section is a small unit being worked on a five year cropping rotation, with no pasture years included. The crops consist of four sold crops and one green manure crop. All plant residues are returned to the soil and NPK fertilisers are used on crops at the recommended rates.

The organic and mixed sections are as near identical as possible in area, paddock size, livestock numbers and types, soil types and past cropping history. The basic rotation on both sections is the same, four years temporary pasture, followed by four years cropping. The cropping sequence is winter oats, barley, peas or beans then wheat undersown with pasture seed. Livestock organic residues are applied in the first and seventh years of the cycle.

Livestock comprise dairy cows, poultry, and a few pigs. Cattle have been very carefully chosen to ensure matched herds on both sections.

On the mixed section all livestock organic residues are returned to the soil without composting and NPK fertilisers are used at recommended rates. Pastures consist of clovers and grasses and all livestock feed is grown on the section except a mineral supplement which is supplied in the form of a lick.

All organic residues are composted before return to the soil on the organic section. No mineral fertilisers are used and in addition to clovers and grasses, the pastures contain deep rooting herbs. A mineral supplement is supplied in the form of dried sea-weed meal.

Preparatory work started in 1939, and in 1952 with rotations and management patterns fully established, a biochemist was engaged, and analytical work commenced.

Analyses on the soil, an alkaline clay loam or clay on glacial parent material, established that there were no fundamental mineral deficiencies.

The unit of time for assessing results from the experiment will be the rotation period, and although a full cycle of results is not yet available certain differences between the three systems are apparent already.

Available N P & K are determined monthly for each paddock. Large seasonal variations in mineral availability occur. The following table gives figures for available P_2O_5 during one annual cycle.

	Stockless	Mixed	Organic
February	19	13	29
May	13	15	17
July	20	16	20
October	10	14	27
December	9	7	24

The mean levels of available Fe for all paddocks in 1957 were stockless 66 p.p.m., mixed 71 p.p.m. and organic 140 p.p.m.

Monthly soil organic matter determinations are made on each paddock. Organic matter is steadily increasing in the organic section. It is constant on the mixed section, and is declining on the stockless section.

Crops grown on the organic section produce markedly larger and deeper root systems than crops receiving artificial fertilisers.

On the mixed and organic sections crops yields are approximately equal. The mineral and protein

level in crop products is also approximately equal on both sections.

Grain selected for seed from each section is screened to remove thin grains. The percentages of screenings in wheat from each section over recent years have been approximately as follows: organic 5 per cent.; mixed $7\frac{1}{2}$ per cent. and stockless 10 per cent.

Milk production per cow and milk protein level are higher on the organic grass than on the mixed section.

Determinations of the vitamin content of fresh grass have just been started. The only available figures suggest that the Vitamin C level in organic grass is double that in mixed section grass.

On the stockless section soil structure is starting to decline. The soil becomes easily waterlogged in winter, and badly cracked in summer.

In answer to a question, Lady Eve explained that because of the nature of the experiment, financial losses have occurred on all sections. The loss however, has been least on the organic section because of lower costs.

The Work of the F.A.O.

Mr. G. E. Mulgrue, F.A.O. Regional Advisor for Information South East Asia, in an address to the South Australian Branch.

The world is extremely short of food. Half of its 2,700 million people are starving and yet the population is increasing by 120,000 per day.

Although the amount of food produced per head has just caught up to what it was before the war, the big producing countries such as America and Australia, are producing more while the under developed countries are producing less. Food production in Asia is still 10 per cent. less than it was before the war. The surplus stocks of food in the world, even if they could be distributed, would be too small to be of any significance.

The Food and Agriculture Organisation of the United Nations works towards world peace by getting people better fed. It aims to achieve this by showing people in the under-developed countries how to produce more food where it is needed.

The more fortunate countries should co-operate in this work for humanitarian reasons to increase world trade, and because underfed people will readily accept any political system which promises more food.

Only countries that earn an income from exports can afford to buy foods from other countries. Underdeveloped countries in Asia and South America could only buy 10 cents per head worth of goods from U.S.A. whereas such countries as France, Australia and Canada bought 10 dollars worth.

In Australia and America, one farmer produces enough food to feed 14 people, whereas in Asia the average farmer does not produce sufficient food for himself.

The work of F.A.O. is along 2 main lines; its regular programme of operations, and bringing technical assistance to under-developed countries.

In the regular programme, F.A.O. fosters co-operation between different countries in the control of diseases and in the organisation of fisheries and forestry commissions. It runs conventions on such topics as plant protection and disease control. For instance in 1952, 16 countries west of the Iron Curtain had an outbreak of Foot and Mouth disease which caused losses of 624 million dollars. F.A.O. has now persuaded these countries to work together in warning each other of these outbreaks, in dealing with them, and in preparing vaccine to be used against the disease.

Text books dealing with almost every phase of agriculture, forestry and fisheries are available for governments. These are produced by about 400 highly trained technicians in Rome.

Schools, training courses, and seminars are held to help technicians in their various fields.

F.A.O. is also working to reduce the vast amounts of food lost by disease, pests and unsatisfactory storage, by constantly gathering information and passing it on to the member governments. About 20 per cent. of the food produced is lost annually in this way.

Although many of these regular programme operations are not spectacular, they often show excellent results; for example, hybrids of maize introduced by F.A.O. to Europe since the war have given increases in yield worth 24.5 million pounds in a year, which is more than F.A.O. has cost since it began.

F.A.O. has 600 experts in countries all over the world showing people how to increase their standards of living by producing more food. They often introduce very simple techniques, especially into countries which cannot afford mechanisation on a big scale. For example, the introduction and instruction in the use of the flaying knife in Libya made it possible for skins to be exported for the first time. The use of scythes in Afghanistan enabled

a man to work at four times the rate that he could with the cutting knife which he previously used.

At the same time vast projects are afoot such as the development of the Mekong, one of the world's biggest rivers.

In Asia and Africa where farmers usually depend on the buffalo for pulling the plough and supplying milk and meat, about 1,000,000 cattle per year are killed by Rinderpest. F.A.O. technicians were able to clear up an outbreak in Thailand with a vaccine. They have now almost totally eradicated Rinderpest from Ethiopia by a vigorous inoculation programme and cattle are being exported for the first time in thousands of years. Adjacent British territory gains about £3,000,000 from having the source of Rinderpest infection removed.

It is sometimes advantageous to accustom people to new foods such as fish, an excellent source of protein. It would not be difficult to double the world's fish production, but remarkably few people eat fish. An F.A.O. economist and nutritionist from Denmark, at the request of the Chilean Government went to Chile to encourage people to eat more fish. By a vigorous publicity campaign the production and consumption was increased by 150 per cent. He is now on a similar assignment in Yugoslavia.

The suggestion of an F.A.O. expert in Ceylon to fit outboard motors to Catamarans enabled eight times as much fish to be caught as before. F.A.O. helped the Government set up credit arrangements which allow fishermen to borrow money to buy their own power boats. They can usually pay back the loans within six years.

There is often little incentive for a farmer to produce more when he is working for a landlord who may also be his shopkeeper and money lender. Interest rates of 200 per cent. per annum are not unusual. F.A.O. is helping Governments to eliminate such practices by setting up agricultural credit systems, marketing arrangements and co-operatives and by carrying out land reform.

It is necessary for F.A.O. experts to leave trained men to carry on the work initiated, otherwise much of their work is lost when they leave. In the Fellowship System, the F.A.O. expert chooses a promising person from the staff lent him by the receiving Government, and he is sent away to learn about the job, so that he is fitted to take over where the F.A.O. expert leaves off.

It must be stressed that the help is not all in the same direction as experts from all over the world go to many different countries. For example, in Afghanistan, there are Chinese, Australians, French,

Greeks and Germans, and in the Philippines, an Israeli, Englishmen, Americans, an Australian, a Chinese, a Swede, and a Dutchman freely exchanging their technical knowledge.

All these co-operative efforts must help world peace.

Hyparrhenia hirta —

A Promising Pasture Species

Mr. A. W. Humphries, Division of Plant Industry, C.S.I.R.O., in an address to the Western Australian Branch.

In 1943, Mr. E. T. Bailey transferred his activities from Queensland to Western Australia. He brought with him a considerable knowledge of plants, and a packet of seed of C.P.I. 5786, a strain of *Hyparrhenia hirta*. This grass had been received by C.S.I.R.O. in 1934, from the Botanical Gardens in Leyden, Holland. That it was not native to the gardens was apparent from its known distribution, and from its appearance and growth habits. It has little in common with the grasses generally found in humid regions such as the Netherlands.

Hyparrhenia hirta is a bush grass of upright habit. In some strains, the mature stem may attain a height of two metres or more. The leaves are typically grey-green, and harsh to the touch. The florets are small, and densely mounted on paired racemes. The florets occur in pairs, one of which is awnless, and invariably sterile. There is a striking lack of variation within most of the strains which we have collected, and this is possibly due to an apomictic mode of reproduction. In nature, grasses called *H. hirta* enjoy an extremely wide distribution, and we have collections from a great deal of the African continent, and from all sides of the Mediterranean basin, as far as Portugal. These collections, however, vary exceedingly in almost all respects, and my imagination is strained by the thought of all this diversity being crammed into one species.

C.P.I. 5786 flourished in rows in the plant introduction nursery, to an extent which excited some interest in it. Commencing in 1951, Dr. R. C. Rossiter conducted an experiment, lasting several years, in which *Hyparrhenia* was compared with phalaris (*tuberosa*) and pyp grass (*Ehrharta villosa*). Each grass was grown in association with subterranean

clover and volunteer annuals. The plots were sampled for yield, five times each year, with a heavy grazing following immediately after each sampling. He found that total production of dry matter was about equal on the phalaris and pyp grass plots, while the *Hyparrhenia* plots yielded 50 per cent. more in the first year of sampling, and 100 per cent. more in the subsequent two years. Furthermore, the *Hyparrhenia* was found to be highly resistant to the grazing method used, and also to burning. The latter treatment was imposed by chance, but has since been employed regularly on a seed increase plot.

Rossiter's results were subsequently repeated and extended in an experiment which I conducted over the years 1955-1958. Once again *Hyparrhenia* was the outstanding grass in comparison with phalaris, perennial veld grass, and smilo (*Oryzopsis miliacea*). A new finding, which I believe has an important bearing on the economic use of this grass, was that, under conditions where the three other species showed marked responses to nitrogen fertilizer, *Hyparrhenia* showed a minor response only.

From these small-plot experiments, we went on to an experiment on a scale which permitted continuous grazing. In this, a $\frac{3}{4}$ -acre plot of *Hyparrhenia* is under comparison with an equal area of annual pasture. From the break of season in 1956, until October 1958, each plot was stocked at 2½ wethers per acre, a rate which we know from some years of experience, is about the maximum carrying capacity of annual pasture at the Regional Laboratory. Time does not permit a detailed discussion, but it was clear that at the rate of stocking specified, the perennial pasture was continually undergrazed. We had to employ the mower on a number of occasions, and were constantly trying to even out the grazing on the *Hyparrhenia* plot. During last October, the stocking rate was doubled on the *Hyparrhenia* plot, bringing the rate per acre to 5½ wethers. In spite of a rather dry summer, and an exceptionally late break to the current season, this rate has been maintained. It is possible that we have gone too high for permanent stocking, but there is no doubt that this pasture will permanently sustain a considerably greater number of animals than an annual pasture based on subterranean clover.

The spectacular increase in productivity achieved by this perennial grass is due primarily to its ability to utilise moisture, stored deep in the sub-soil, during the summer months. In addition to this, it appears to be able to obtain its nutrient requirements very efficiently from the infertile sands in

which we have grown it. Coupled with these assets is the extraordinary resistance to grazing conferred by the growth habit of the grass. The basal stems form a dense harsh tuft which successfully repels the attentions of the sheep.

So much for the credit side. On the debit, we must place two serious limitations. First, and most serious, is that it is not easy to obtain satisfactory stands from seed. I have already noted that 50 per cent. of the florets are invariably sterile. The other 50 per cent. set seed rather erratically, and whatever seed is set is shed rapidly after ripening. Laboratory studies have shown that this elusive seed requires average temperatures of about 15°C for satisfactory germination and about 25°-30°C for optimum germination. These temperatures are higher than those that Nature provides in our soils during the growing season. Secondly, the established plant is fairly susceptible to cold and to frost. On the Coastal Plain, this is of little consequence, but for the time being at least, the area of potential use is limited by the Darling Scarp.

In an attempt to overcome these limitations, I have got together a strain collection totalling about 150 distinct forms. The only thing known for certain about this large collection is that an enormous amount of work needs to be done with it. However, preliminary observations do justify limited optimism regarding germination and cold tolerance. In addition to selection and evaluation studies on these strains, much more research is needed in other directions. The more important of these are as follows:—

1. *Pasture establishment.* Not merely the problem outlined above of the germination of *Hyparrhenia*.

It is possible that the use of this grass will be impeded by the familiar difficulty of establishing pasture legumes on sandy soils. A great part of the area of potential use of *Hyparrhenia* is subject to this problem.

2. *Plant nutrition and soil fertility.* I have placed these two broad problems together because in deep, poor sands, the economic use of fertilizers, and the maintenance and increase of soil fertility are intimately associated. We do have some preliminary data which indicate that fertility increases much more rapidly in the presence of a good stand of *Hyparrhenia* than in its absence. If this is verified by further work, then it should be of great economic significance.

3. *Plant water relations.* Many infertile sands possess hydrophobic properties which prejudice pasture establishment and lower pasture production. This requires investigation, as does also the pattern of water use which is so vital to the growth of *Hyparrhenia* in our dry summer period. Research on water relations would materially assist in interpreting fertility changes and the utilization of applied nutrients.

It will be some time before our limited resources can cope with the problems I have briefly outlined. For the moment, I feel able to say that it is likely, but by no means certain, that *Hyparrhenia hirta* will become a valuable addition to the agricultural plants of this State. What is more certain is that the research which will be stimulated by this species will increase our knowledge of plant-soil relationships in the coarse, infertile sands so characteristic of this State. Perhaps, in the long run, this will be the more valuable asset.

Nuffield Farming

Scholarships

Nuffield Foundation Farming Scholarships have been awarded to Mr. S. L. Dilkes of Bridgetown, Western Australia, and Mr. P. J. Young of Kybybolite, South Australia.

These Scholarships are offered each year to Australian farmers to enable them to spend about six months in the United Kingdom, visiting farms and agricultural institutions and generally gaining experience of the kind that will be valuable to them on their return home. This year two awards were offered to farmers resident in South Australia, Western Australia and the Northern Territory.

Mr. Dilkes runs a 400 acre dairy property at Bridgetown, W.A., in partnership with his brother. Sidelines in the farms activities are the production of pigs, baby beef and apples. In Great Britain he plans to study production of high quality milk and cream, artificial breeding schemes and farm improvement methods.

Mr. Young is a Soldier Settler on a 600 acre block at Kybybolite, S.A., producing fat lambs and beef cattle. In Great Britain Mr. Young hopes to study meat production and marketing, pasture improvement and fodder conservation, and farming organisations designed to improve agricultural knowledge.

N.S.W. Department:

Division of Science Services

At Rydalmere near Sydney, a new building for the N.S.W. Department of Agriculture is nearing completion. The building will house the Division of Science Services, under Dr. C. J. Magee, which includes the Chemists', Entomologists' and Biologists' Branches of the Department. The cost will be £381,000, and occupation is expected early next year.

Victorian Grasslands

Society

On September 21, some seventy five people gathered at the School of Agriculture, Melbourne University to consider the formation of a Grassland Society. Unanimous approval was given to a motion that a Society to be known as the Grassland Society of Victoria be formed for the purpose of bringing together farmers, scientists and others interested in the development and use of pastures.

The meeting discussed the role that the society could play and put forward many ideas relating to its programme and its general constitution. A steering committee was formed for the purpose of framing a draft constitution and arranging the first formal meeting on December 4.

It is hoped that this society will enable people with wide and varying grassland interests to meet and exchange ideas. It is felt that a common meeting ground is essential for the farmer, the scientist, the technical and commercial interests, indeed anyone who is interested in pasture development and use. Only in this way can interests be broadened and each specialised group gain an appreciation of the whole field of pasture problems.

It is proposed that the Society be an autonomous one, with an open membership, and in broad outline function in a similar fashion to the British Grassland Society and the New Zealand Grassland Association.

Verco Medal to

Dr. C. G. Stephens

Dr. C. G. Stephens, Head of the Soil Survey & Pedology Section, Soils Division, C.S.I.R.O., Adelaide, has been awarded the Verco Medal for his outstanding work on soils.

The Verco Medal is the highest award which the Royal Society of South Australia can bestow on scientific workers who have made exceptional contributions in their particular field of interests.

Since joining the C.S.I.R. in 1929, Dr. Stephens has published a number of papers dealing with various aspects of classification and mapping of Australian soils and soils genesis, with particular reference to laterites. In 1952, he was appointed Consultant at the F.A.O. headquarters in Rome and later visited Brunei to advise on land settlement and development.

Animal Production School

The Victorian Branch of the Institute, in conjunction with the Victorian Branch of the Australian Society of Animal Production, held a four-day Refresher School on Animal Production from Monday, August 31, to Thursday, September 3, 1959 at the Burnley School of Horticulture. Its purpose was to bring agriculturalists up to date with the latest research findings in the animal industries and also their practical applications. Prominent Victorian and interstate workers in the various fields of animal production were obtained as speakers.

The Refresher School proved very successful, the total enrolment being 169. Many farmers and some interstate visitors were present. Also, 14 Senior Fellows from India, who were in Australia for a Post-Graduate Sheep and Wool Course, attended the School. There was an average of 90 persons at each of the 22 sessions.

Ninety people attended the buffet dinner held at Burnley Gardens at 6 p.m. on the first day of the School. At the buffet dinner the Refresher School was opened officially by the Hon. C. H. Bridgford, M.L.C.

Papers presented at the Refresher School were as follows:—

Reproductive Physiology

Dr. R. H. Watson—General principles of reproductive physiology in sheep.

Mr. L. P. Prewett—General principles of reproductive physiology in cattle.

Growth and Lactation

Mr. N. M. Tulloh—Growth and development in relation to meat production.

Dr. P. G. Schinckel—Follicle development and wool growth.

Mr. J. B. Coombe—Milk secretion and let down.

Mr. H. P. Edgoose—Influence of farm environment on milk yield and composition.

Genetics and Animal Breeding.

Dr. J. A. Morris—General Review of animal genetics.

Mr. P. G. Hyland—Selection for wool production.
Mr. F. Skaller—Selection for egg production.

Mr. I. L. Mason—Genetic improvement of beef cattle.

J. S. Barker—Genetic improvement of dairy cattle.
Mr. D. S. Wishart—Artificial insemination in cattle.

Nutrition

Dr. F. J. R. Hird—Special features of ruminant nutrition.

Dr. D. M. Walker—Principles of non-ruminant nutrition.

Dr. R. L. Reid—Problems of feeding the pregnant sheep.

Dr. D. E. Tribe—Feeding the Australian grazing animal.

Mr. A. W. Lloyd—Economic aspects of feeding sheep.

Mr. V. G. Cole—A Review of hand feeding of sheep and cattle in Australia.

Management

Mr. N. G. Cameron—Management of beef cattle properties.

Mr. A. H. Bishop—Intensive management of sheep properties.

Mr. A. G. Goudie—Intensive management of irrigated dairy farms.

Economics

Discussion led by Sir Samuel Wadham—Thoughts about the economic position of the dairy, beef and sheep industries.

Queensland University

The Department of Agriculture of the University of Queensland moved in early June from its old location at George Street to part of the new Biological Block at the University at St. Lucia. There are some 6,000 square feet of laboratory and office space providing excellent facilities and equipment for the Faculty. Total enrolments in the Faculty are nearly 150 including 5 full-time post-graduate students. The two main lines of research in the Department are soil fertility investigations relating to the Darling Downs, and the growing of fodder and conservation of silage in association with sheep-raising in West Queensland.

Further expansion has taken place at the Department's farm at Redland Bay where £6,000 has been spent on additional equipment for the laboratory and the farm plots.

Personal Notes

New South Wales

Professor U. Baron Goto, Professor of Agricultural Extension at the University of Hawaii, was recently in the Murwillumbah area of New South Wales investigating local varieties of Macadamia nuts for crossing with Hawaiian varieties. He was also interested in the Gallop nut in coastal New Guinea—this has a finer flavour than the Macadamia. While in New Guinea he toured highland areas and lectured on growing coffee.

Mr. H. V. Jenkins has been appointed Director of the new Wheat Research Institute at Narrabri. He was earlier associated with the University of Sydney in research at Lismore, and more recently with the Waite Institute where he lectured in Agronomy.

Mr. Peter Ellyard who graduated B.Sc.Agr. this year, has been awarded the coveted Farrer Memorial Scholarship, which he will take up in the U.S.A. on studies on water requirements of wheat. The award is for two years.

Prof. J. R. A. McMillan is at present touring Agricultural establishments in New Zealand.

Dr. K. J. Whiteley has been appointed Lecturer in Fibre Science in The School of Wool Technology, The University of New South Wales. Recently he returned from the University of Leeds where he was awarded his doctorate for a thesis entitled *The Relationship between Wool Quality and Fibre Substance*. In his new position, Dr. Whiteley is continuing to investigate anomalies in the performance of wool fibres.

Mr. E. H. Jacob of the Chemists' Branch, Department of Agriculture, recently attended the annual conference of the Cereal Group of the Australian Chemical Institute in Adelaide; he presented a paper on wheat segregation and grading.

Mr. H. M. Hassel has been appointed Agricultural Adviser to the recently formed District Advisory Service in Wagga. He was previously with the Soil Conservation Service in northern New South Wales.

Victoria

Mr. W. B. Miller, Superintendent of Agriculture, Department of Agriculture, returned from an overseas trip during October. Mr. Miller visited the U.S.A., Canada, France, and the United Kingdom. He inspected many research institutions concerned with cereal and pasture production and studied extension methods used in each country.

Mr. P. Ryan, Director of Agriculture is at present overseas studying the agricultural scene in the United Kingdom. During November he represented the Australian States on the Commonwealth Delegation to the F.A.O. General Assembly in Rome. *Mr. B. F. McKeon*, Senior Technical Executive Officer, Department of Agriculture recently returned from an overseas trip. While abroad he visited research centres in U.K. and the continent and then studied agricultural extension and research in the U.S.A. under a SEATO Leader Fellowship.

Mr. J. P. Brien, Research Officer, Department of Agriculture returned in October after spending 12 months in the U.S.A. and U.K. studying agricultural communication services. Mr. Brien received a Wisconsin University scholarship and graduated M.Sc. at the completion of his studies.

Mr. A. L. Tisdall has been elected President-elect of the Institute for the current year. Mr. Tisdall was President of the Victorian Branch in 1956.

Mr. P. F. Shea, Assistant Research Officer of the State Rivers and Water Supply Commission has been granted a Research Assistantship at the University of California, U.S.A. and a Fulbright Travel Grant.

Mr. Shea has been working on ground water problems and will further his studies under Dr. J. N. Luthin, Associate Professor of Irrigation at Davis, California.

Mr. H. D. Johnston has been elected President of the Association of Dairy Technologists.

Dr. M. Freer, who recently obtained his Doctorate for studies on grazing management, is at present spending twelve months in the U.K.

Mr. G. Douglas has been appointed graduate member and Deputy Chairman of the recently created Vermin and Noxious Weeds Destruction Board in the Lands Department.

Queensland

Mr. G. J. P. McCarthy, Plant Pathologist of the Department of Agriculture and Stock, has been transferred from Brisbane to Nambour.

Mr. B. J. Crack has returned to the Plant Nutrition Section of the Department of Agriculture and Stock from the University of California, Berkeley, where he obtained his M.S. in Soil Science. Mr. Crack studied under a King George VI Fellowship and was able to visit various soils research establishments in the Mid-west and Eastern United States; his interests particularly concern sodic soils.

Mr. J. J. Yates Agrostologist with the C.S.I.R.O. has been transferred from the Cunningham Laboratory in Brisbane to the Cooper Laboratory at Lawes. He joins *Mr. L. Edye* who was recently transferred there while *Mr. R. Milford* is away in England.

Mr. J. Kotalawala of the Department of Agriculture, Ceylon, is undertaking post-graduate studies in the University Department of Agriculture on the phosphorus nutrition of tomatoes.

Another overseas visitor, *Mr. M. V. Ahmed*, a Lecturer in Soil Science at the University of Dacca, is in Queensland for several months studying sugar cane agronomy. He has spent some time at the University investigating various soil-testing methods.

Mr. W. Arndt of the C.S.I.R.O., Katherine, Northern Territory is at the University Department of Agriculture studying the effect of rainfall on crusting of soil. He has constructed apparatus to produce artificial rainfall of the same characteristics as natural rainfall.

South Australia

Mr. R. F. Hazelgrove has departed for Europe where he will study viticultural practices. He plans to spend much of his time in France and Spain.

Dr. F. G. Jarrett of the Economics Department, University of Adelaide, has been granted 12 months study leave to work at the Michigan State University. He has been awarded a Rockefeller Fellowship and will study livestock marketing in U.S.A.

Dr. J. Melville has been awarded a Carnegie Grant for overseas study. He hopes to leave in February 1960.

Professor C. M. Donald is now at Cornell University, U.S.A., where he will deliver a series of lectures on Plant Competition.

Mr. R. F. Seamark, 1959 Barr Smith Scholar, has arrived in England, and will shortly go into residence at St. John's College, Cambridge.

Dr. D. L. Hayman has recently been appointed Lecturer in Genetics at the University of Adelaide. He was formerly a Research Officer in the Division of Plant Industry at Canberra.

Mr. J. M. Allgrove, Technical Representative of Swift and Co. Ltd., Adelaide, has been appointed Manager, Agricultural Division at Head Office of this firm in Sydney.

Mr. T. C. Miller, Chief Horticulturist, Department of Agriculture, has been appointed a Member and Chairman of the South Australian Potato Board.

Dr. B. G. Coombe, Viticultural Research Officer, Department of Agriculture, has resigned from the Department of Agriculture. He took up the appointment as lecturer in the Department of Plant Physiology at the Waite Institute. He recently, returned from Davis, California, where he completed his Ph.D. degree.

Mr. J. V. Mertin was recently re-elected President of the Agricultural and Veterinary Chemicals Association (S.A. Division) and is that body's representative on the Council of the S.A. Chamber of Manufactures Inc.

Tasmania

Mr. G. Dimmock has returned from New Zealand after an exchange visit of 9 months at Alexandra in Central Otago with the Soil Bureau of D.S.I.R. During his stay Mr. Dimmock was working on a soil survey to determine the irrigation potential of the area.

Mr. A. G. Wilson, who arrived from England a short time ago is now Assistant District Horticultural Officer in the Huon Valley area. He has recently been admitted to corporate membership.

Branch Notes

New South Wales

Two successful symposia, each attended by about 70 members, have been held in recent months.

The question Is there a Place for More Agricultural Consultants was discussed at the July meeting by Messrs. R. A. Pearce, Lecturer at the University of New England, H. E. B. Shaw, President, Bombala District Rural Advisory Service and W. A. Beattie, Agricultural and Pastoral Consultant, Melbourne.

Finance for Rural Development was the topic for the October Symposium. The speakers were Mr. P. C. Druce, of the N.S.W. Department of Agriculture and Mr. C. P. Dowsett of the Rural Bank of N.S.W.

Other branch activities include a canvass to increase membership as at present only 55 per cent. of graduates are members, and the setting up of a new sub-committee to investigate the Agricultural Extension Services in the State and to assist farmers in the formation of consultant services.

Plans for 1960 are well in hand. A meeting will be held in the irrigation area early in the year to sponsor a new sub-branch; there are 60 members in the area. A joint meeting with the Northern Sub-branch will also be held in August. Topics for the meeting will centre about agricultural problems of the region.

Victoria

The Branch conducted a Rural Sociology Seminar in October at the School of Agriculture, Melbourne University. The seminar was arranged with the co-operation of Professor Wilkenning, Professor of Rural Sociology at the University of Wisconsin, who is attached to the School of Agriculture as a Fulbright Scholar.

Professor Wilkenning was the main speaker and also summed up the reports of individual discussion groups.

The programme included the following papers: Acceptance of technological changes in farming as a social process, Scope and uses of Rural Sociology, Process of decision making, Role of the Advisory Officer in bringing about changes in farming.

The seminar created considerable interest amongst members and provided some valuable discussion on extension techniques.

The Branch is grateful to Professor Wilkenning for his assistance in both the planning and execution of the seminar.

The annual dinner was held on September 23 at the William Angliss Food Trades School. One hundred and fifty members and guests partook of an excellent meal and enjoyed selected wines, the merits of which were discussed by the guest speaker, Mr. D. Wynn, President of the Australian Wine and Brandy Producers Association (Victoria).

The Committee is endeavouring to make the dinner a more popular function, as, being held during the Royal Melbourne Show period, it enables many country members to attend and is in fact the means of bringing a wide representation of members together at the one time.

A special meeting held during September discussed the matter of Associates within the Institute. Opinions were expressed by the majority of those attending and all branch members have received a summary of the ideas which were put forward. It is felt that in this way all members will be well informed on the subject and thereby enabled to vote in an effective manner.

The Branch has taken an active interest in the formation of the Grassland Society of Victoria and was pleased to offer assistance in its development. An account of the Grassland Society appears elsewhere in this Journal.

Queensland

Dr. I. F. Phipps, Technical Manager, Biologicals Division, I.C.I.A.N.Z. Ltd., Melbourne, and Hon. General Secretary of the Institute addressed the ordinary general meeting of August 26 on Chemicals in Agriculture.

The September ordinary general meeting was replaced by a Centenary Dinner as the Queensland Branch of the Institute's contribution to the celebrations of Queensland's Centenary Year. The Dinner was held at Finney Isles, Brisbane and was attended by 42 members and 66 guests drawn from industry, agricultural and pastoral organisations, and the State and Commonwealth public services. Mr. W. J. S. Sloan, Director of Plant Industry of the Department

of Agriculture and Stock, proposed the toast to the State of Queensland, and Professor T. K. Ewer, Professor of Animal Husbandry in the University of Queensland, proposed the toast to the Institute to which Mr. J. A. Roberts, the Institute's Executive Officer replied. The Centenary Address, Rural Development in Queensland, was delivered by Colonel J. K. Murray and will be published in the Institute Journal. Mr. F. Chippendale, Queensland Branch President-Elect moved a vote of thanks to Colonel Murray following which the Australian Medal of Agricultural Science for 1959 was presented to Mr. C. G. Hughes and Mr. D. R. L. Steindl by Mr. A. L. Tisdall, Federal President-Elect of the Institute. The Dinner received favourable publicity in the Press and it is considered that the evening materially enhanced the status of the Institute and the profession in Queensland.

Five officers from the Department of Agriculture and Stock at Toowoomba addressed the October ordinary general meeting on Problems arising during One Hundred Years of Agriculture on the Darling Downs. The speakers and their particular topics were:

Mr. W. J. Roche, Soil Conservationist — Soil erosion, emphasising the causes rather than the effects;

Mr. J. W. Littler, Agronomist — Fertility decline and its effect on wheat quality and yield;

Mr. J. K. Leslie, Agrostologist — Pastures and related nutritional problems;

Mr. A. W. S. May, Senior Entomologist — Changing attitude towards methods of insect control;

Mr. T. McKnight, Senior Pathologist — Changing pattern of plant diseases.

A sub-committee of the Queensland Branch Committee has been appointed as a Student Advisory Committee to provide a guidance service to undergraduates, graduands, and students in early post-graduate years. Members are Professor L. J. H. Teakle, Professor of Agriculture, Dr. D. O. Norris, C.S.I.R.O. Plant and Soils Laboratory, Mr. W. J. S. Sloan, Department of Agriculture and Stock, Mr. F. W. Blackford, A.C.F. and Shirleys Fertilisers Ltd., and Mr. O. W. Sturgess, Bureau of Sugar Experiment Stations as Convenor. Over half the third and fourth year students availed themselves of the service. The Committee discussed with fourth year students employment prospects and opportunities for post-graduate training, and offered third year students advice on selection of their fourth year subject for specialisation.

South Australia

At a meeting held on August 28, Mr. G. E. Mulgrue spoke on The Work of F.A.O. in South East Asia. He is stationed at Bangkok as Regional Adviser for Information for South East Asia.

The Branch will hold a Seminar for Industry at Roseworthy Agricultural College on Tuesday, November 24.

The Seminar will be entitled The Chemist and Nature. Institute speakers will discuss Insect Control. Nitrogen as a Fertilizer, Fungus Diseases, and Plant Growth Regulation. Mr. Lewis, Officer-in-Charge, Industrial Liaison Section, C.S.I.R.O., has agreed to come to Roseworthy to give the evening address on Synthetic Fibres in Relation to the Wool Industry.

The Committee has decided that representatives from Industry and those taking part in the Seminar will be the guests of the Branch on that day.

At the request of the Branch Committee a Sub-committee on Graduand Affairs has been convened by Dr. C. G. Stephens. He has asked Professor R. C. Morton, Dean of the Faculty of Agriculture, Mr. H. P. C. Trumble, Department of Agriculture, Mr. A. J. Brink, Industry and Mr. P. C. Angove, Branch Committee, to assist him.

The Sub-committee has met to clarify its thinking about assistance it may be able to offer to graduating and post graduate students.

The Sub-committee as a whole and individually will be available to offer advice to Students about vocational opportunities.

To enable the Sub-committee to know the 1959 graduands and honours students personally, a small social function has been arranged.

Western Australia

Recent meetings of the Branch have taken the form of public meetings to discuss general farming problems.

The first, entitled What's Wrong with the Dairy Industry? was held in Perth in September and was addressed by a producers' representative, a processor and a scientist, Dr. L. C. Snook. Although reasonably well attended by non-members, this meeting was not supported by members of the Institute. It suffered from a lack of the spirited discussion which

might have been expected. The approach of the Dairy Industry Committee of Enquiry's Perth hearing may have had a dampening effect on the meeting.

A meeting held at Northam, with the co-operation of the local branch of the Farmers' Union, was much more successful. It was very well attended by farmers and, considering the distance of 60 miles from Perth, by Institute members. The subject, The Problem of Low Lambing Percentages, was a popular one, and the meeting seemed to be a real success. It was addressed by Institute members H. Lloyd-Davies, H. Fels and H. G. Neil and by Brookton farmer R. Overheu.

A special meeting was held in September to hear a talk by Professor E. A. Wilkening, Professor of Rural Sociology from the University of Wisconsin.

Recommendations in a report submitted by the sub-committee on salaries and status were submitted to a postal vote, and all were agreed to. Several dealing with possible direct action by the Institute to improve salaries and status received fairly strong opposition but all were carried by a safe margin.

The more interesting of these items were:

- A. A proposal to be put to Federal Council to investigate the possibility of the formation of an association to represent agricultural scientists throughout Australia in salary negotiations, the association to seek registration under the Commonwealth Conciliation and Arbitration Act.
- B. That a suitable salary scale be prepared for use by professional agricultural scientists throughout Australia, to be used by existing employment groups wishing to negotiate with their employers.
- C. Formation of a permanent sub-committee on employment conditions other than salary by the W.A. branch of the Institute. This committee would help members with problems relating to employment conditions, report on current employment conditions in W.A., and assist undergraduates in Agriculture on their problems of future employment.

The branch annual dinner was held on October 6, at the Charles Hotel. It was voted a good dinner, and greatly enjoyed by those who attended, but the comparatively high cost of £2 a head apparently limited the attendance.

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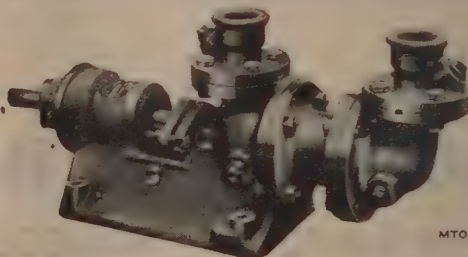
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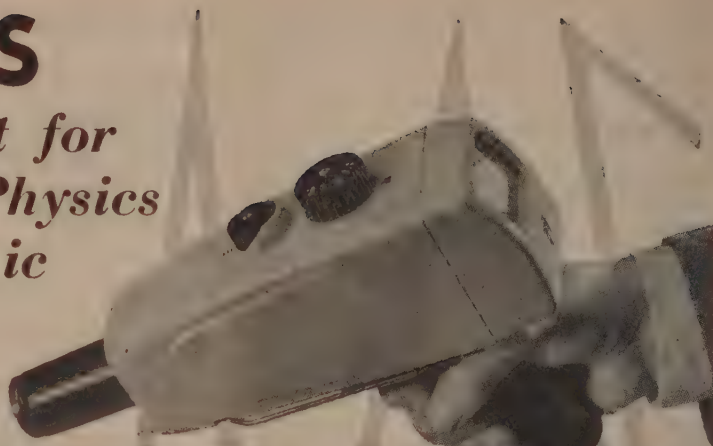
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Department of Agriculture

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One appointee will be stationed at Wanbi Research Centre (situated 140 miles east of Adelaide) and be required to undertake the additional duties of management of the Centre. A house is available at the Centre at a rental to be fixed.

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Applicants should state any preference for the above appointments.

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